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NATIONAL DAM SAFETY PROGRAM. WHITE OAK DAM. (VA 11301), RAPPAHA--ETC(U)
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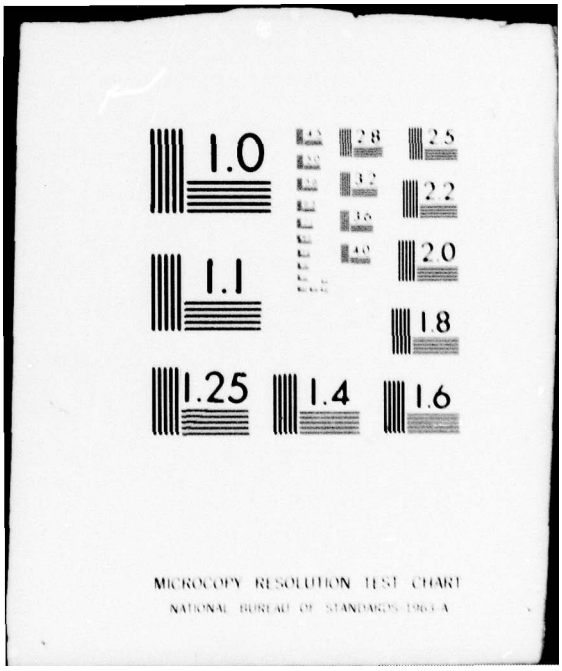
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RAPPAHANNOCK RIVER BASIN

Name Of Dam: White Oak
Location: Madison County, State of Virginia
Inventory Number: VA 11301

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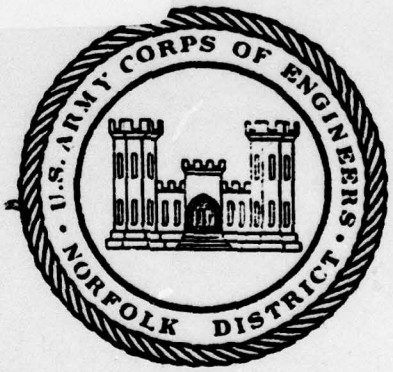
PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM



MARCH 1979

PREPARED FOR

NORFOLK DISTRICT CORPS OF ENGINEERS
803 FRONT STREET
NORFOLK, VIRGINIA 23510

BY

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20. Abstract

Pursuant to Public Law 92-367, Phase I Inspection Reports are prepared under guidance contained in the recommended guidelines for safety inspection of dams, published by the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general conditions of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

Based upon the field conditions at the time of the field inspection and all available engineering data, the Phase I report addresses the hydraulic, hydrologic, geologic, geotechnic, and structural aspects of the dam. The engineering techniques employed give a reasonably accurate assessment of the conditions of the dam. It should be realized that certain engineering aspects cannot be fully analyzed during a Phase I inspection. Assessment and remedial measures in the report include the requirements of additional indepth study when necessary.

Phase I reports include project information of the dam and appurtenances, all existing engineering data, operational procedures, hydraulic/hydrologic data of the watershed, dam stability, visual inspection report and an assessment including required remedial measures.

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of the Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (flood discharges that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the design flood should not be interpreted as necessarily posing a highly inadequate condition. The design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

CONTENTS

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam: White Oak
State: Virginia
County: Madison
Stream: White Oak Run
Date of Inspection: 28 November 1978

BRIEF ASSESSMENT OF DAM

White Oak Dam is an earth dam approximately 65 feet high and 500 feet long. The dam is owned and operated by the Town of Madison, Virginia and was designed by the U.S. Soil Conservation Service (SCS). The visual inspection and review of as-built drawings indicated no serious deficiencies requiring emergency attention.

According to Corps of Engineers' criteria, the dam should pass a spillway design flood equal to the Probable Maximum Flood. The dam will safely pass 67 percent of the Probable Maximum Flood without overtopping. Therefore, the spillway is inadequate but not seriously inadequate. Evidence of seepage or slope instability that would threaten the integrity of the structure was not observed. However, stability analyses completed during the design of the dam show that upstream and downstream berms recommended during the design were not shown on the design drawings and were not constructed. The available design documents do not explain the omission of the berms. Re-examination of the embankment stability is recommended within one year of the date of this report.

Recommended remedial measures to be scheduled during the annual operation and maintenance inspection program are to: remove debris from the reservoir area, remove small trees and brush from the embankment, and repair animal burrows.

MICHAEL BAKER, JR., INC.

Michael Baker, III, P.E.
Chairman of the Board and
Chief Executive Officer

COMMONWEALTH OF VIRGINIA
MICHAEL BAKER III
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Douglas L. Haller
Colonel, Corps of Engineers
District Engineer

Date: MAR 23 1979

OVERALL VIEW OF DAM

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
NAME OF DAM: WHITE OAK ID# VA 11301

SECTION 1 - PROJECT INFORMATION

1.1 General

1.1.1 Authority: Public Law 92-367, 8 August 1972 authorized the Secretary of the Army, through the Corps of Engineers to initiate a national program of safety inspections of dams throughout the United States. The Norfolk District has been assigned the responsibility of supervising the inspection of dams in the Commonwealth of Virginia.

1.1.2 Purpose of Inspection: The purpose is to conduct a Phase I inspection according to the Recommended Guidelines for Safety Inspection of Dams. The main responsibility is to expeditiously identify those dams which may be a potential hazard to human life or property.

1.2 Description of Project

1.2.1 Description of Dam and Appurtenances: White Oak Dam is a zoned, earthfill dam approximately 65 feet high and 500 feet long. Seepage control is provided by an impervious core, cutoff trench, and seepage drains. The seepage drains to the left (east) and right (west) of the outlet pipe lie along the toe of the dam and consist of filter material and perforated 6 inch B.C.C.M.P. Both drains exit into the stilling basin beside the outlet pipe.

The 75 foot wide, vegetated, side-channel, emergency spillway is located outside the right abutment of the dam. The approach channel slope is about 2% to the level control section which is 30 feet long. The discharge slope of the emergency spillway is about 15%.

The principal spillway is a drop-inlet structure consisting of a reinforced concrete riser, a 36 inch diameter reinforced concrete outlet pipe, and a riprap-lined stilling

basin approximately 40 feet wide and 60 feet long. A steel catwalk, 2.5 feet wide and supported by four piers, provides access to the riser (see Photo 1).

The reservoir is used for flood control and water supply. There are two 25 inch high by 36 inch wide orifices which are located on the upstream and downstream faces of the riser. The invert elevation of the orifices is 581.3 feet M.S.L. which maintains normal pool of the reservoir. The high stage riser crest is at an elevation of 586.5 feet M.S.L. Three water supply gates are located on the right (southwest) side of the riser with invert elevations at 559.0, 572.5, and 577.0 feet M.S.L. The 36 inch slide gate, which is used as a reservoir drain, and one water supply gate are located on the left (northeast) side of the riser with invert elevations of 547.0 and 568.0 feet M.S.L., respectively. The plan and typical sections of the dam are shown on Plates 1, 2, and 3.

1.2.2 Location: White Oak Dam is located on White Oak Run approximately 3 miles west of the Town of Madison in Madison County, Virginia. A Location Plan is included in this report.

1.2.3 Size Classification: The maximum height of the dam is 65 feet, and the reservoir storage capacity to the top of dam elevation is 2229 acre-feet. Therefore, the dam is in the "intermediate" size category as defined by the Recommended Guidelines for Safety Inspection of Dams.

1.2.4 Hazard Classification: Two farms are located along White Oak Run immediately downstream (within the first mile) of the dam. Due to the close proximity of these habitable structures and the possible loss of life in event of failure as defined by Section 2.1.2 of the Recommended Guidelines for Safety Inspection of Dams, White Oak dam is considered in the "high" hazard category. The hazard classification used to categorize dams is a function of location only and has nothing to do with its stability or probability of failure.

1.2.5 Ownership: The dam is owned and operated by the Town of Madison, Virginia with maintenance assistance from the Culpeper Soil and Water Conservation District and the regional U.S. Soil Conservation Service (SCS).

1.2.6 Purpose of Dam: The dam is used for water supply and flood control within the Rappahannock River Basin.

1.2.7 Design and Construction History: The existing facility was designed for the owner by the SCS. The dam, completed in 1965, was built by Moore, Kelly and Reddish, Inc.

1.2.8 Normal Operational Procedures: Except for water supply, operation of the dam is automatic. Normal pool is maintained by the orifice inlets on the riser with invert elevations of 581.3 feet M.S.L. The crest of the principal spillway is located at an elevation of 586.5 feet M.S.L. Excess flow is diverted through the emergency spillway which has a crest elevation of 592.0 feet M.S.L. The reservoir drain with an invert elevation of 547.0 feet M.S.L. can be used to dewater the reservoir.

1.3 Pertinent Data

1.3.1 Drainage Area: The drainage area of White Oak Dam is 5.06 square miles.

1.3.2 Discharge at Dam Site: The maximum discharge at the dam site was estimated at approximately 250 c.f.s. (includes flow from principal and emergency spillways), based on the June 1972 flood with a depth in the emergency spillway of about 0.5 foot.

Principal Spillway:

Pool level at emergency spillway crest	198 c.f.s.
Pool level at top of dam . . .	221 c.f.s.

Emergency Spillway:

Pool level at top of dam . . .	9050 c.f.s.

1.3.3 Dam and Reservoir Data: Pertinent data on the dam and reservoir are shown in the following table:

TABLE 1.1 DAM AND RESERVOIR DATA

Item	Elevation feet M.S.L.	Reservoir Capacity: Area acres	Reservoir Capacity: Acre-feet(a)	Reservoir Capacity: Watershed inches	Length feet
Top of dam	603.8	100.5	2229	8.26	5700
Maximum pool, design surcharge	600.4	89.0	1889	7.00	5200
Emergency spillway crest	592.0	68.9	1239	4.59	4400
Principal spillway crest	586.5	57.5	895	3.32	3800
Normal pool (b)	581.3	49.4	629	2.33	3200
Streambed at centerline of dam	539.0	-	-	-	-

(a) Total storage -- includes 129 acre-feet of sediment storage and and 500 acre-feet of water supply storage below normal pool.

(b) Invert of the two 25 by 36 inch orifices.

SECTION 2 - ENGINEERING DATA

2.1 Design: The design data reviewed was obtained from the SCS and included the following:

1) As-built drawings by the SCS indicating plans, elevations, and sections of the dam and appurtenant structures. Logs of test borings and test pits were also included in the as-built drawings (Appendix I).

2) Design report by the SCS including geologic and soil data, laboratory test results, hydrologic and hydraulic calculations, and structural design calculations. Stability analyses and geologic reports are included in Appendices VI and VII, respectively. Hydrology and hydraulic design data are discussed in more detail in paragraphs 5.1 and 5.8.

3) Annual operation and maintenance inspection reports for the past 3 years (Appendix V).

All existing data have been filed with the Norfolk District for future reference.

2.2 Construction: The dam; constructed by Moore, Kelly and Reddish, Inc.; was completed in 1965. Construction records were not available for this inspection; however, as-built drawings were reviewed and were subsequently verified in the field. Construction reports are on file in Washington, District of Columbia.

2.3 Operation: There are no formal operating procedures for this dam. In June 1972, the local SCS office reported that a flood peaked at approximately a 6 inch depth in the emergency spillway (combined discharge of principal and emergency spillway therefore was 250 c.f.s.).

2.4 Evaluation:

2.4.1 Design: The as-built drawings and design report were adequate to assess all aspects of design except slope stability. The slope stability calculations appear to be inconsistent, and the berms recommended in the calculations were not constructed (see Section 6). The omission of berms was not explained in the SCS Design Report. The hydrologic and hydraulic data provided was adequate for design review. The assessments made in this report are based on this design data along with field observations.

2.4.2 Construction: No construction logs were available for review. However, as-built drawings indicate modifications and changes made during construction.

2.4.3 Operation: Annual operation and maintenance inspection reports were available for review (see Appendix V).

SECTION 3 - VISUAL INSPECTION

3.1 Findings

3.1.1 General: White Oak Dam was inspected on 28 November 1978. No unusual weather conditions were experienced, and the lake was at normal pool elevation. The dam and appurtenant structures were found to be in good overall condition at the time of inspection. The problems noted during the visual inspection were not considered to be serious and do not require immediate remedial treatment.

3.1.2 Dam: No serious deficiencies were observed which affect the stability of the dam. Clear flow from three 6 inch B.C.C.M.P. drains (see Photo 3), which collect water from the seepage drain, was measured at 0.0 g.p.m., 0.1 g.p.m., and 0.4 g.p.m. in the vicinity of the outlet of the principal spillway. Small trees and bushes have grown in several areas of the embankment including the slope gutters at the left abutment. A small animal burrow is located in the right downstream slope. Some small trees are growing on the right of the cut slope of the emergency spillway.

3.1.3 Appurtenant Structures: No signs of significant deterioration were observed in the structures. The concrete surfaces on the riser and exposed portion of the outlet pipe were in good condition.

3.1.4 Reservoir Area: No serious deficiencies were observed in the reservoir area (see Photo 1). However, some wood debris near the left shoreline of the dam was observed.

3.1.5 Downstream Channel: The stilling basin (see Photo 2) and outlet channel are functioning properly, and the riprap is generally in good overall condition. A slide-erosion area 20 feet wide by 18 feet high (see bottom of Photo 4) occurs on the right of the stilling basin approximately 30 feet from the toe of the dam. The slide-erosion area has displaced some riprap.

3.2 Evaluation: None of the above items are considered to be serious, but the wood debris should be removed and the animal burrow should be filled in and seeded. The slide in the cut slope for the stilling basin has not impaired the use of the basin and is apparently not active. Periodic inspection of the slide area is advised. A staff gage should be installed to monitor reservoir levels above normal pool.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures: Operational procedures are generally discussed in paragraph 1.2.8. Water supply for the Town of Madison is supplemented during periods of low flow in White Oak Run by releases from the dam. According to the annual operation and maintenance inspection reports (see Appendix V), the four water supply gate valves were successfully opened and closed during the 1977 inspection. The reservoir drain is not operated periodically to check for proper functioning. Annual operation and maintenance inspections are conducted by the Town of Madison with the assistance of the Culpeper Soil and Water Conservation District and the regional SCS office.

4.2 Maintenance of Dam: Maintenance of the dam is provided by the Town of Madison, Virginia.

4.3 Maintenance of Operating Facilities: Maintenance of the water supply valves and reservoir drain is provided by the Town of Madison. The water supply valves were operated successfully in 1977.

4.4 Warning System: At the present time, there is no formal warning system or evacuation plan in operation. However, the dam and reservoir are checked during periods of intense rainfall.

4.5 Evaluation: Considering the functions served by the operational facilities, maintenance is considered adequate.

SECTION 5 - HYDRAULIC/HYDROLOGIC DATA

5.1 Design: Normal pool (elevation 581.3 feet M.S.L.) is controlled by two 25 inch high by 36 inch wide orifices (one each on the upstream and downstream sides of the riser). Normal pool was established at an elevation sufficient to store 500 acre-feet of water supply and the 50-year sediment accumulation. The riser crest was established at an elevation (586.5 feet M.S.L.) to store an additional 0.98 inches of flood runoff. The capacity (198 c.f.s. with the reservoir level at the emergency spillway crest) of the principal spillway was established by consideration of a number of factors including:

1) The capability of evacuating the flood storage space within a reasonable time (less than 10 days).

2) Not passing damaging floods downstream.

3) The capability of the reservoir to store the floodwaters.

The crest (elevation 592.0 feet M.S.L.) of the emergency spillway was established at the elevation needed to store the 100-year, 10-day rainfall. The elevation of the top of dam (603.8 feet M.S.L.) was established by the maximum elevation reached in passing the freeboard hydrograph. The freeboard hydrograph was developed for a class "b" structure and was obtained by using 1.75 x 6 hour point rainfall and moisture condition II. This produced a 6 hour storm rainfall of 20.5 inches.

5.2 Hydrologic Records: No rainfall or stream flow records were available at the dam site.

5.3 Flood Experience: No exact high water marks were available. However, the local SCS office indicated that the June 1972 flood peak was flowing approximately 6 inches deep in the emergency spillway. Therefore, the discharge from the dam (including the principal spillway) was estimated at approximately 250 c.f.s.

5.4 Flood Potential: Performance of the reservoir by routing the Probable Maximum Flood (PMF), the 1/2 PMF, and the 100-year flood is shown in Table 5.1.

Outlet discharge capacity, and reservoir area and storage capacity were taken from the design report by the SCS. Hydrograph data and routing computations were

calculated as part of this report. Flood routings were begun with the reservoir level at normal pool.

5.5 Reservoir Regulation: Pertinent dam and reservoir data are shown in Table 1.1, paragraph 1.3.3.

Except for water supply, regulation of flow from the reservoir is automatic. Normal flow is maintained by the orifice openings at elevation 581.3 feet M.S.L. and the drop-inlet on the riser crest at elevation 586.5 feet M.S.L. Water entering these inlets flows through the dam in a 36 inch diameter reinforced concrete conduit. Water also flows past the dam through an ungated, vegetated, side-channel, emergency spillway in the event water in the reservoir rises above the spillway crest (elevation 592.0 feet M.S.L.).

5.6 Overtopping Potential: The probable rise in reservoir and other pertinent information on the reservoir performance in various hydrographs are shown in the following table:

TABLE 5.1 RESERVOIR PERFORMANCE

Item	Normal	Hydrographs 100 Year	1/2 PMF	PMF
Peak flow, c.f.s.				
Inflow	-	5292	10,625	21,251
Outflow	-	496	6219	17,610
Peak elev., ft., M.S.L.	581.3	593.5	601.2	606.3
Emergency spillway				
Depth of flow, ft. (a)	-	0.8	5.7	8.9
Avg. velocity, f.p.s.	-	5.1	13.2	16.4
Duration of flow, hrs.	-	7.4	13.1	14.0
Non-overflow section				
Depth of flow, ft.	-	-	-	2.5
Average velocity, f.p.s.	-	-	-	4.2
Duration of overtopping, hrs.	-	-	-	2.6
Tailwater elev., ft., M.S.L.	539.1	-	-	-

(a) Depth at control section, not including velocity head.

5.7 Reservoir Emptying Potential: The time for the reservoir to empty from the emergency spillway crest (discharge of 198 c.f.s.) to normal pool is about 7 days, according to the SCS calculations. The drawdown time from normal pool to the reservoir bottom (drain invert of 547.0 feet M.S.L.) is approximately 3 days.

5.8 Evaluation: White Oak Dam was designed by the SCS as a class "b" structure with point rainfall of 22.75 inches yielding an areal rainfall of 20.5 inches for the freeboard hydrograph. According to the COE criteria, the dam is classified as a "high" hazard-"intermediate" size structure which should pass a spillway design flood essentially equal to the PMF. The dam was evaluated by using a Probable Maximum Precipitation (PMP) of 27.2 inches. The PMF was routed through the reservoir and produced a maximum water surface elevation of 606.3 feet M.S.L. which would overtop the dam by 2.5 feet. The spillway will only pass 67 percent of the PMF.

Conclusions pertain to present day conditions and the effect of future development on the hydrology has not been considered.

SECTION 6 - DAM STABILITY

6.1 Foundation and Abutments: There is 5 to 10 feet of alluvial, silty sand with gravel overlying hard, coarse-grained granite with gneissic structure which dips at 70° in the bottom of the valley. Minor joints are vertical. The bedrock is in the Lovingston Formation of the Blue Ridge complex. The cutoff trench was excavated into the top of firm bedrock and back filled with clay and silt for seepage control.

Approximately 5 feet of brown, damp sand and silt with rock fragments overlies hard granite in the abutment areas. The granite dips at 60°SW with a strike N40°-50°E in the cut of the emergency spillway.

6.2 Stability Analysis

6.2.1 Visual Observations: No evidence of instability in the embankment slopes, spillway cut slopes or concrete structures was observed. A small slide has occurred in the cut for the stilling basin on the right side, 30 feet downstream from the toe of the dam. Minor flow was measured from two outlet pipes collecting water from the seepage drain. No evidence of serious damage was observed from high water.

6.2.2 Design Data: Available design data appears to represent stability calculations performed on two occasions. The first design set accompanies an SCS office memorandum dated 17 July 1963. The second design set accompanies calculations done in March 1964.

1963: Slope stability was checked by both the Sliding Wedge Method and a modification of the Swedish Circle Method. A sliding wedge analysis was used because of the possibility of a shallow foundation failure. The zoned embankment sections chosen for these analyses showed the shell of the dam adjacent to the impervious core with slope ratios of 1 horizontal to 1 vertical (1:1). Side slopes of the dam were indicated as 2.5:1 over 3:1 on the upstream side and 2.5:1 on the downstream side. The following shear strength parameters were used for the foundation and embankment soils:

	Classification	ø	C (p.s.f.)
*core.....	CL	31.5°	300
*shell.....	ML	33.5°	0
**foundation.		25°	100

The shear strength of the soils was determined from remolded samples compacted at 95% of standard density. The samples were saturated and subjected to consolidated, undrained, triaxial shear tests.

Minimum safety factors computed were 1.37 for the upstream slope under full drawdown at Station 7+00 and 1.12 at Station 6+57. Addition of a 26 foot berm at elevation 566.0 feet M.S.L. would increase the factor of safety to 1.34.

The Swedish Circle Method of analysis resulted in a factor of safety of 1.15 for the same conditions with a 5 foot thick foundation. It was determined that a 28 foot berm at elevation 566.0 feet M.S.L. was required to raise the factor of safety to 1.50.

1964: No memorandum accompanies these calculations and they appear to be incomplete. Table 6.1 summarizes the calculations found in Appendix VI.

The calculations indicate that the upstream safety factor would be increased if the foundation soil was replaced with a higher strength material. The downstream safety factor was 1.41 with the foundation soil in place and no berms. This result conflicts with the calculations done in 1963.

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* From strength tests.
** Estimated by SCS.

TABLE 6.1

CONDITION	POOL ELEVATION (feet M.S.L.)	SLOPE	TYPE OF ANALYSIS	ø	C (p.s.f.)	SAFETY FACTOR
Foundation Soil Not Excavated	592.0	U/S	Circular Arc	Emb. 31.5 Fdn. 25	300 100	1.26
Foundation Soil Excavated	592.0	U/S	Circular Arc	Emb. 18.5 Fdn. 18.0	0 1000	1.44
Foundation Soil Not Excavated	592.0	U/S	Wedge	Emb. 18.5 Fdn. 33.5	500 0	1.57
Foundation Soil Not Excavated	*	D/S	Circular Arc	Emb. 31.5 Emb. 33.5 Fdn. 25	300 0 100	1.41

U/S - Upstream
D/S - Downstream

* Pool elevation not given.

NAME OF DAM: WHITE OAK

The as-built conditions are similar to the embankment sections used in the stability analyses. However, the 26 foot wide berm on the upstream side and the 28 foot wide berm on the downstream side, which were required to raise the factors of safety to acceptable levels, were not constructed. The as-built drawings also show that the foundation soil was not removed and replaced with compacted material.

6.2.3 Operating Records: With the exceptions of encroaching brush and trees in several areas, the yearly inspection reports indicate that no seriously deteriorating conditions have developed. Heavy brush has apparently been removed in the emergency spillway, but some small trees still remain in other areas.

6.2.4 Post-Construction Changes: No alterations of the dam were apparent since its construction.

6.2.5 Seismic Stability: White Oak Dam is in Seismic Zone 2 and is considered to have no hazard from earthquakes according to the Recommended Guidelines for Safety Inspection of Dams, provided static stability conditions are satisfactory and conventional safety margins exist.

6.3 Evaluation: The additional berms on the upstream slope (26 feet wide) and on the downstream slope (28 feet wide) required to raise the factor of safety to 1.50 were not constructed.

The design and as-built drawings indicated that foundation soils were not removed outside of the cutoff trench area. Because the embankment stability analyses demonstrated the need for either the addition of berms (which were not built) or the removal of foundation soil (which was not excavated), it is recommended that the stability of the embankment and the soil strengths be further examined to confirm the necessity of the originally recommended measures.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment: The discharge capacity of White Oak Dam is insufficient to pass the PMF which is the spillway design flood (according to "intermediate" size-"high" hazard classification). The spillway will pass approximately 67 percent of the PMF. Therefore, the spillway is inadequate but not seriously inadequate.

The slide-erosion area at the end of the emergency spillway on the right bank of the stilling basin (which could have resulted from flow in the emergency spillway in June of 1972) does not show signs of recent movement or erosion. There does not appear to be a need for additional riprap protection at this time; however, the area should be checked during the annual inspections.

The data available was sufficient to evaluate the adequacy of design. As-built drawings and the visual inspection of the dam indicate no serious departure from design plans. However, berms and foundation soil excavation that were recommended during the design stage were not included during final design and construction. It is recommended that the stability of the embankment be re-examined.

The dam will not require urgent remedial treatment.

7.2 Recommended Remedial Measures: The inspection revealed certain preventative maintenance items which should be scheduled during the annual operation and maintenance inspections. These are:

1) Remove small trees and brush on the embankment.

2) Remove debris in the reservoir area.

3) Excavate and fill animal burrows on the embankment.

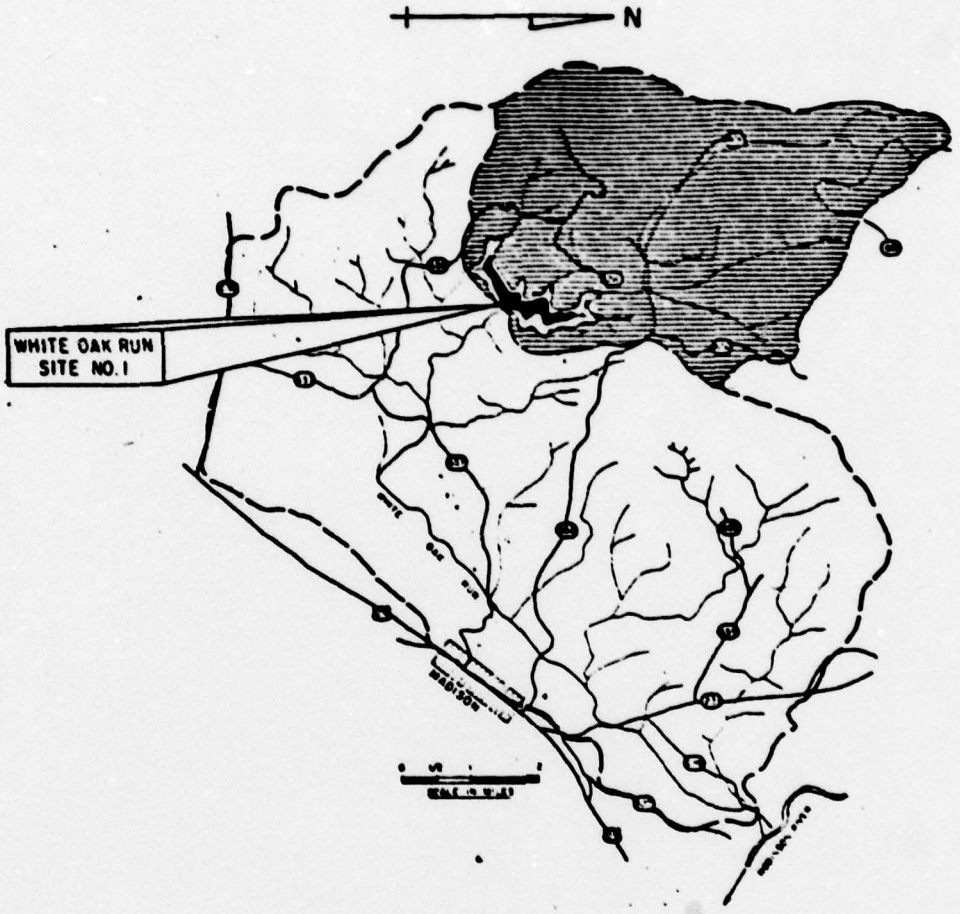
4) Install a staff gage to monitor reservoir levels above normal pool.

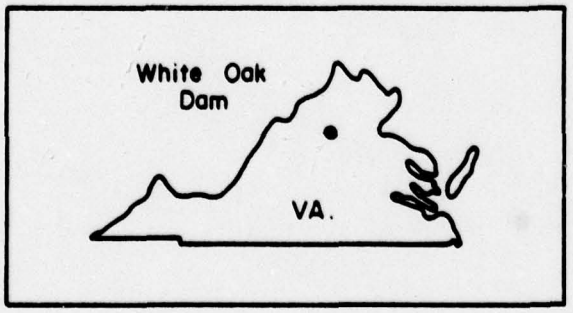
APPENDIX I

PLATES

CONTENTS

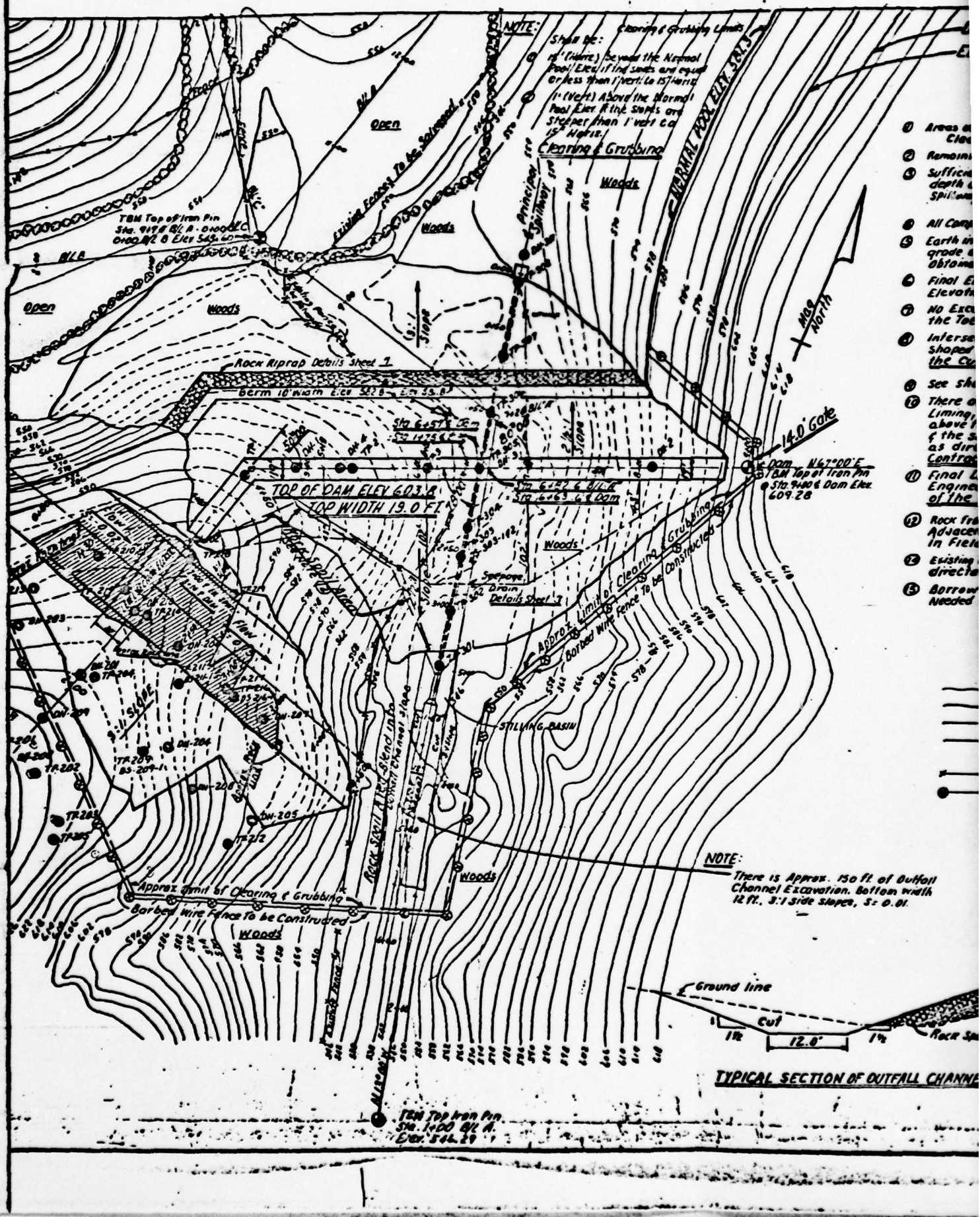
NAME OF DAM: WHITE OAK

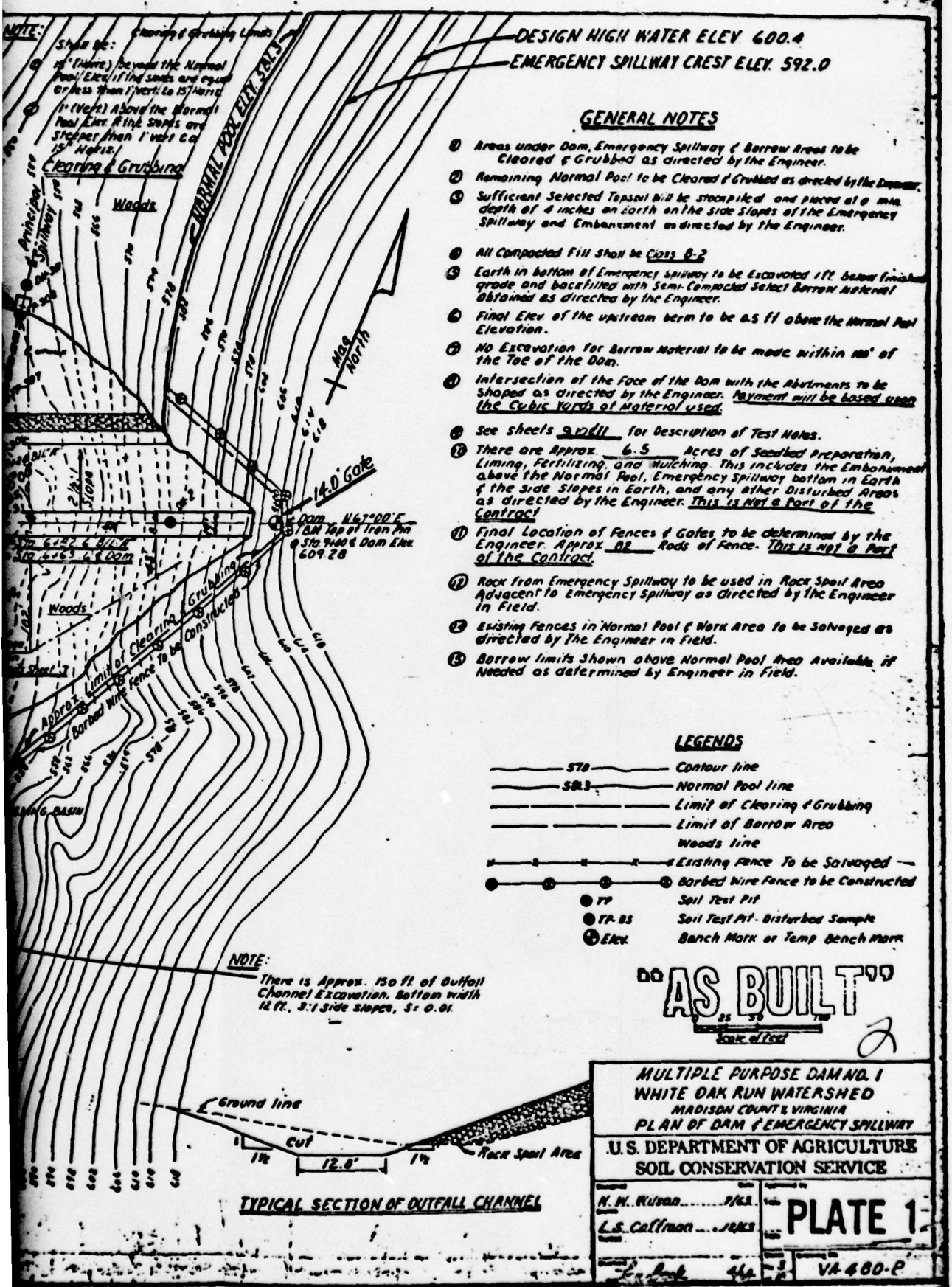




LOCATION PLAN

WHITE OAK DAM


NOTE:
Clearing & Grubbing Limits Shall be:
a) (Where) beyond the Normal Pool Elev. if fill slopes are equal or less than 1' vert. to 1½' horiz.
b) (Where) Above the Normal Pool Elev. if fill slopes are steeper than 1' vert. to 1½' horiz.
Clearing & Grubbing
NORMAL POOL ELEV. 584.5
Principal Spillway
Existing Fence To be Removed
TBM Top of Iron Pin Sta. 9+17.8 Q/L A - 0+00.0 Q/L C Offset Q/L B Elev 549.60
Open
Woods
Rock Riprap Details Sheet 1
Berm 10' Width Elev 592.8
14.0' Gate
Dam N47°00'E
TBM Top of Iron Pin Sta. 9+00 & Dam Elev. 609.28
TOP OF DAM ELEV 603.8
TOP WIDTH 19.0 FT
Spillway Drain
Details Sheet 3
Approx. Limit of Clearing & Grubbing
Barbed Wire Fence To be Constructed
STILLING BASIN
Rock Spill Trap Spillway Channel Stone
Flow Line
Slope
MAG North
NOTE:
There is Approx. 150 ft. of Outfall Channel Excavation. Bottom width 12 ft., 3:1 Side Slopes, S= 0.01.
Ground line
Cut
12.0'
TYPICAL SECTION OF OUTFALL CHANNE
TBM Top Iron Pin Sta. 1+00 Q/L A. Elev. 544.29



NOTE:
Shall be:
① 15" (Fifteen) Above the Normal Pool Elev. if the Slopes are equal or less than 1 (Vert.) to 1.5 (Horiz.)
1" (Vert.) Above the Normal Pool Elev. if the Slopes are Steeper than 1 (Vert.) to 1.5" (Horiz.)

TYPICAL SECTION OF OUTFALL CHANNEL

GENERAL NOTES

1. Areas under Dam, Emergency Spillway & Borrow Areas to be Cleared & Grubbed as directed by the Engineer.
2. Remaining Normal Pool to be Cleared & Grubbed as directed by the Engineer.
3. Sufficient Selected Topsoil will be stockpiled and placed at a min. depth of 4 inches on Earth on the side Slopes of the Emergency Spillway and Embankment as directed by the Engineer.
4. All Compacted Fill Shall be Class B-2
5. Earth in bottom of Emergency Spillway to be Excavated 1 ft. below finished grade and backfilled with Semi-Compacted Select Borrow Material Obtained as directed by the Engineer.
6. Final Elev. of the upstream berm to be 6.5 ft above the Normal Pool Elevation.
7. No Excavation for Borrow Material to be made within 100' of the Toe of the Dam.
8. Intersection of the Face of the Dam with the Abutments to be Shaped as directed by the Engineer. Payment will be based upon the Cubic Yards of Material used.
9. See Sheets 2 thru 11 for Description of Test Holes.
10. There are Approx. 6.5 Acres of Seedbed Preparation, Liming, Fertilizing, and Mulching. This includes the Embankment above the Normal Pool, Emergency Spillway bottom in Earth & the side Slopes in Earth, and any other Disturbed Areas as directed by the Engineer. This is Not a Part of the Contract
11. Final Location of Fences & Gates to be determined by the Engineer. Approx. 82 Rods of Fence. This is Not a Part of the Contract.
12. Rock from Emergency Spillway to be used in Rock Spoil Area Adjacent to Emergency Spillway as directed by the Engineer in Field.
13. Existing Fences in Normal Pool & Work Area to be Salvaged as directed by the Engineer in Field.
14. Borrow limits Shown above Normal Pool Area Available if Needed as determined by Engineer in Field.

LEGENDS

- 570 — Contour line
- 582.3 — Normal Pool line
- Limit of Clearing & Grubbing
- Limit of Borrow Area
- Woods line
- Existing Fence To be Salvaged
- Barbed Wire Fence to be Constructed
- TP — Soil Test Pit
- TP-BS — Soil Test Pit - Disturbed Sample
- Elev. — Bench Mark or Temp Bench Mark

NOTE:
There is Approx. 150 ft. of Outfall Channel Excavation. Bottom width 12 ft., 3:1 Side Slopes, S = 0.01

"AS BUILT"
0 25 50
Scale of Feet

MULTIPLE PURPOSE DAM NO. 1
WHITE OAK RUN WATERSHED
MADISON COUNTY, VIRGINIA
PLAN OF DAM & EMERGENCY SPILLWAY

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

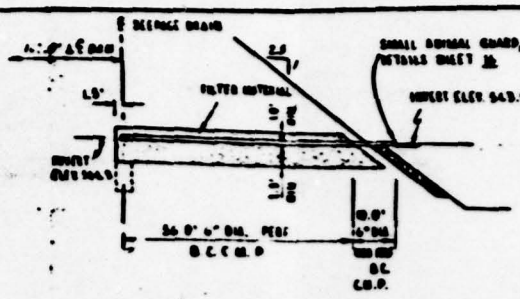
N. W. Rusgo ... 7/63
L.S. Coffman ... 7/63
Lr Look 46

PLATE 1

VA-460-P

NOTES

1. The Seepage Drain Pipes Perf & Non-Perf Shall be 6" dia Annular or Spiral 16 Gage Bitu Coated Corrugated Metal Pipe with std Coupling Bands
2. All Perf Pipe shall be laid with 5/16" dia Perforations on lower side.
3. All Seepage Pipes shall be surrounded by a min of 1.0' of Filter Material.
4. Total of Perforated Pipe = 192.0 FT
   Total of Non-Perforated Pipe = 20.0 FT

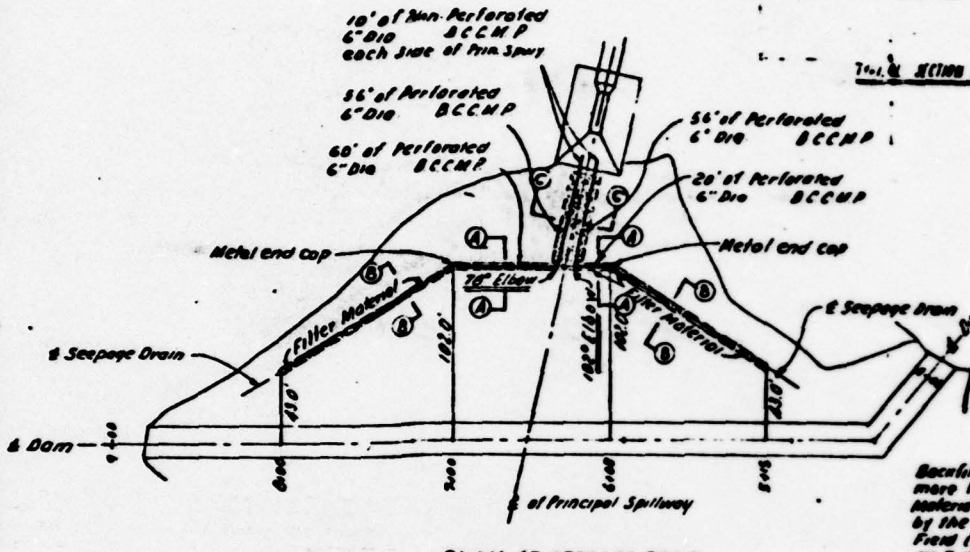


TYP. SECTION ALONG OUTLET DRAIN PIPE

SECTION A-A

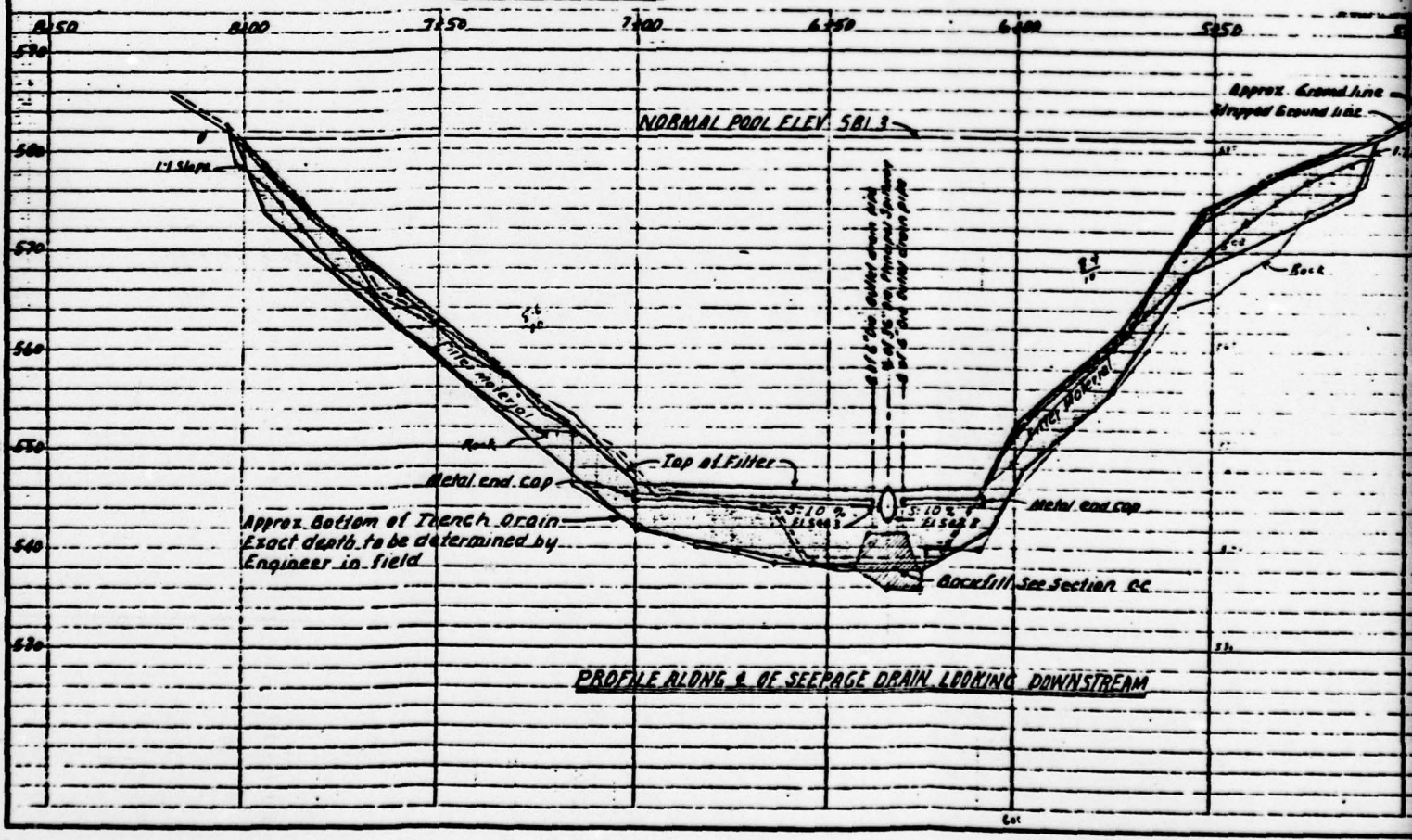
SEEPAGE

Rock Riprap to be placed in Area to form a Rock Fill of least 2' thick. Min. Size Rock Riprap Bedding least 1' in thickness Placed in this Area. Material to be used will be well graded between 3/4" & 8 1/2"

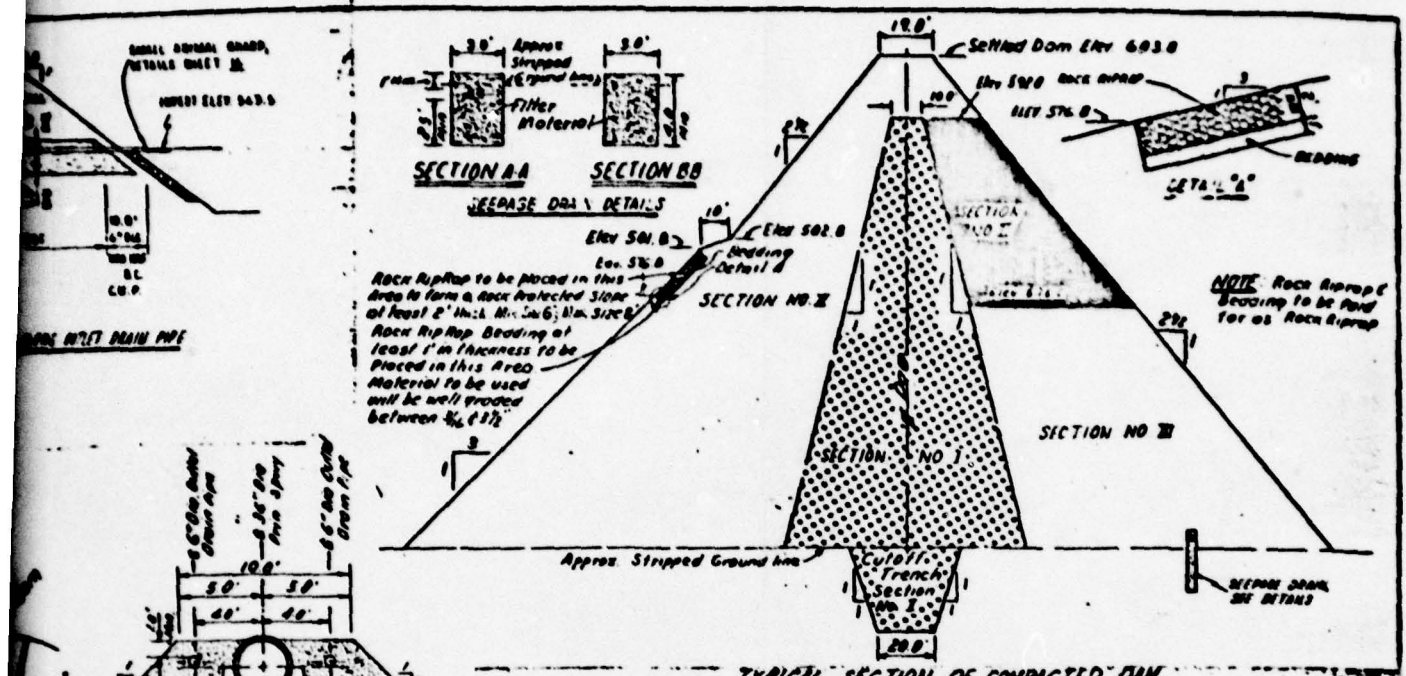


PLAN OF SEEPAGE DRAIN

SECTION CC



PROFILE ALONG ℄ OF SEEPAGE DRAIN LOOKING DOWNSTREAM



SECTION NO. I

COMPACTED FILL CLASS "G-2" USE SILT (ML) & CLAY (CL) REPRESENTED BY THE LOG OF TEST PITS:

TP 119 FROM 1' TO 9'
TP 121 FROM 1' TO 10'

SECTION NO. II

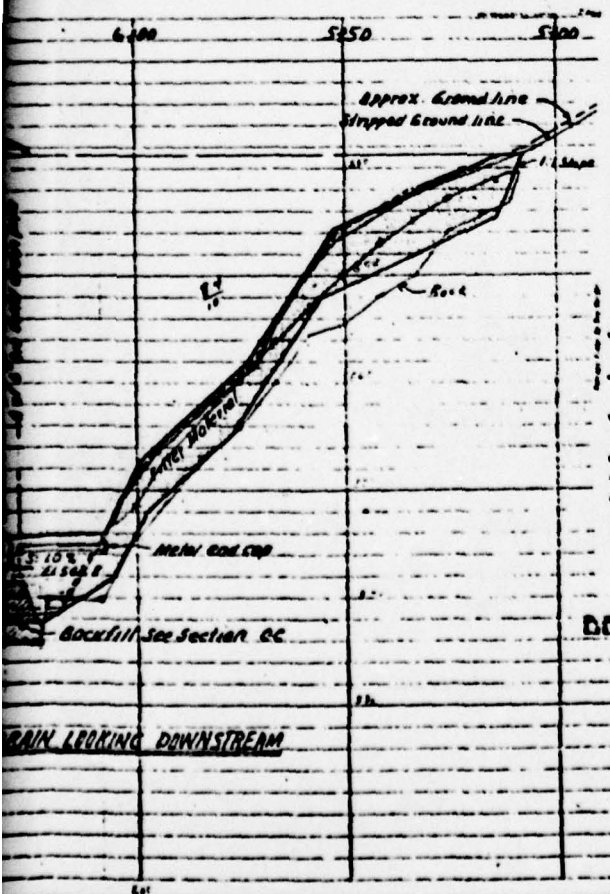
COMPACTED FILL CLASS "G-2" USE SILT (ML) & CLAY (CL) REPRESENTED BY THE LOGS OF TEST PITS:

TP 211 FROM 1' TO 11'
TP 208 FROM 1' TO 6'
TP 100 FROM 1' TO 8'
TP 104 FROM 1' TO 7'
TP 153 FROM 1' TO 11'
TP 157 FROM 1' TO 6'
TP 146 FROM 1' TO 12'

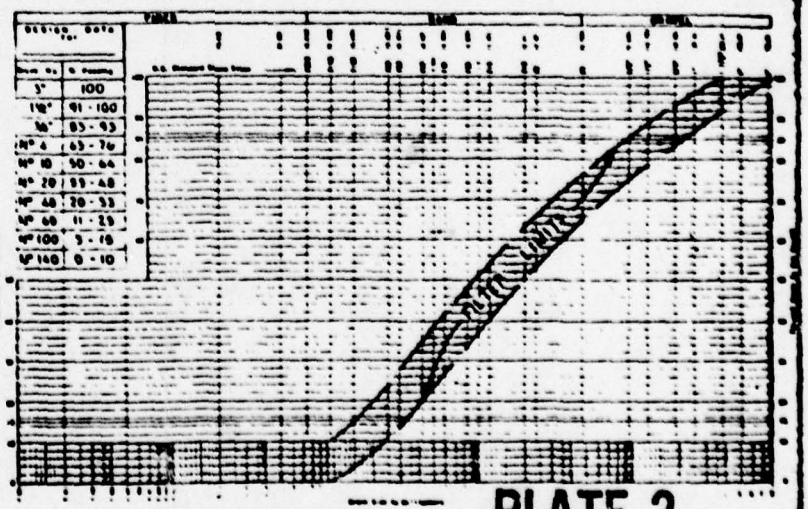
SECTION III

COMPACTED FILL CLASS "G-2" USE SILTY SAND (SM) REPRESENTED BY THE LOG OF TEST PITS:

TP 139 FROM 1' TO 6'
TP 140 FROM 1' TO 8'
TP 146 FROM 1' TO 6'
TP 148 FROM 1' TO 12'



GRAIN SIZE DISTRIBUTION GRAPH



"AS BUILT"

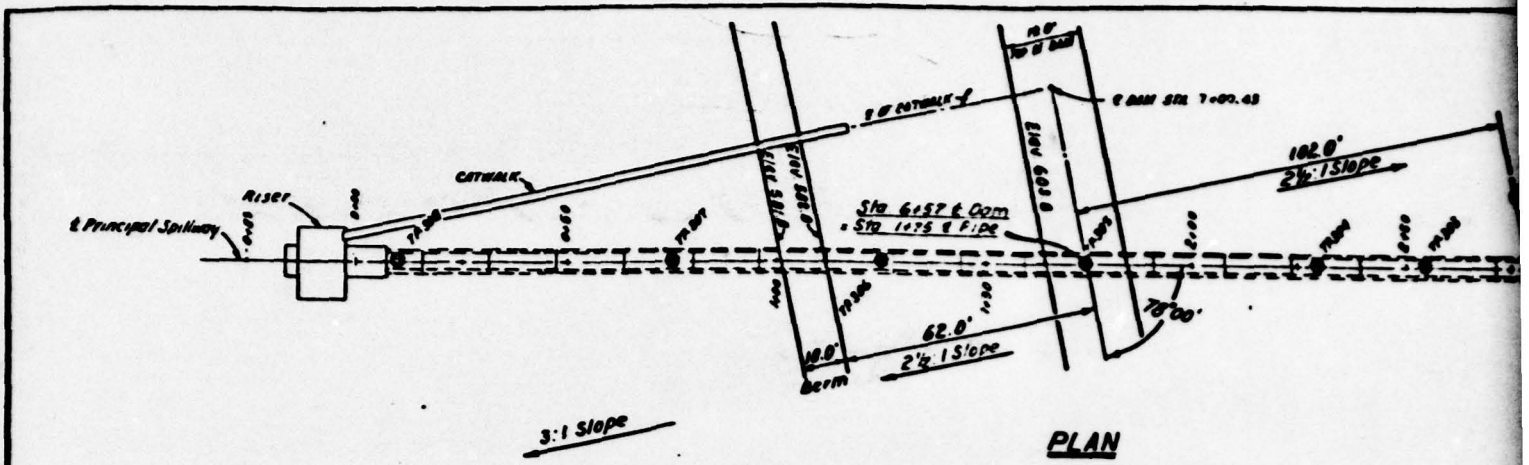
PLATE 2

MULTIPLE PURPOSE DAM NO.1
WHITE OAK RUN WATERSHED
MADISON COUNTY, VIRGINIA
SEEPAGE DRAIN DETAILS & TYPICAL SECTION OF DAM

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

R.W. Pricket, U.S. Butler 4-60
L.S. Coffman 42463
RA BAILD 9-64
VA-480-P

2

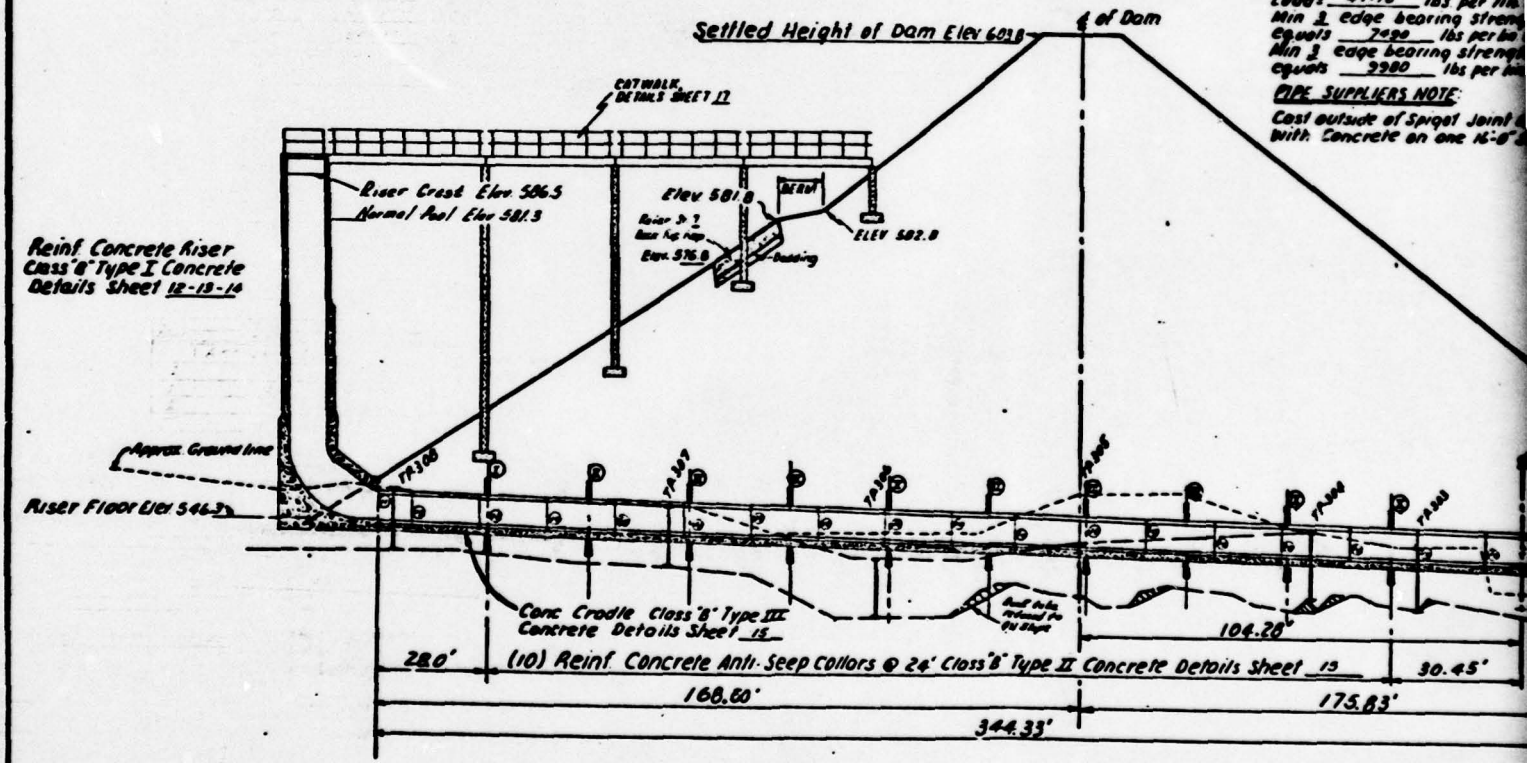


PLAN

Scale

36" I.D. Reinf. Conc. Water
(2) 16'-0" Sections
(1) 12" Wall Piece
Total = 345.33'
Pressure Head = 57.5'
Load = 41170 lbs per lin.
Min 3 edge bearing strength
equals 7490 lbs per lin.
Min 3 edge bearing strength
equals 2990 lbs per lin.

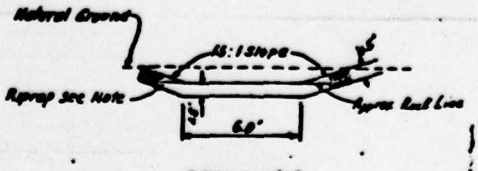
PIPE SUPPLIERS NOTE:
Cast outside of Spigot Joint
With Concrete on one 16'-0"



SECTION ALONG CENTERLINE OF PRINCIPAL SPILLWAY

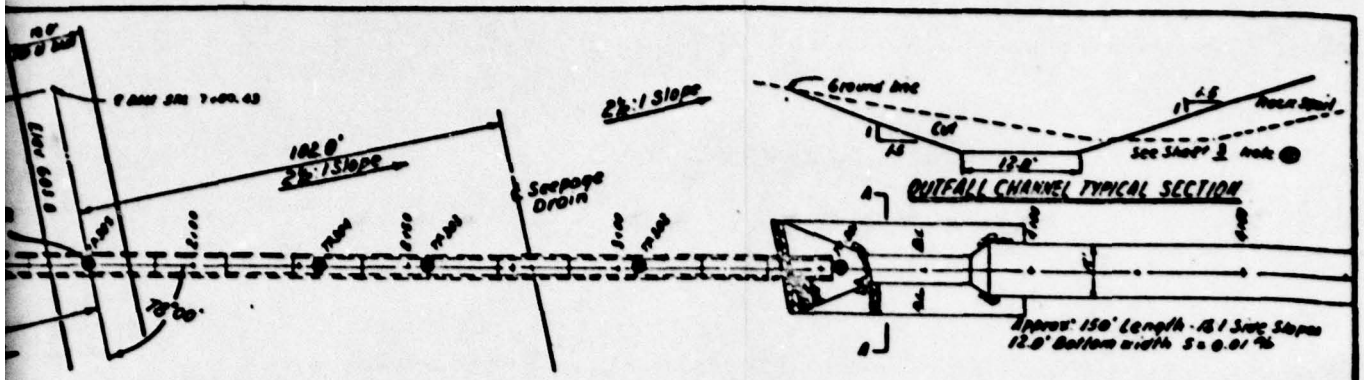
Scale (Horiz.)

Scale (Vert.)



SECTION A-A

NOTE: Riprap shall be well graded from a min size of 6" to a max size of 18". It shall be placed with the longest dimension perpendicular to the line of flow. Backfill bedding with clean sand & gravel, as directed by the Engineer in field.



PLAN

Scale

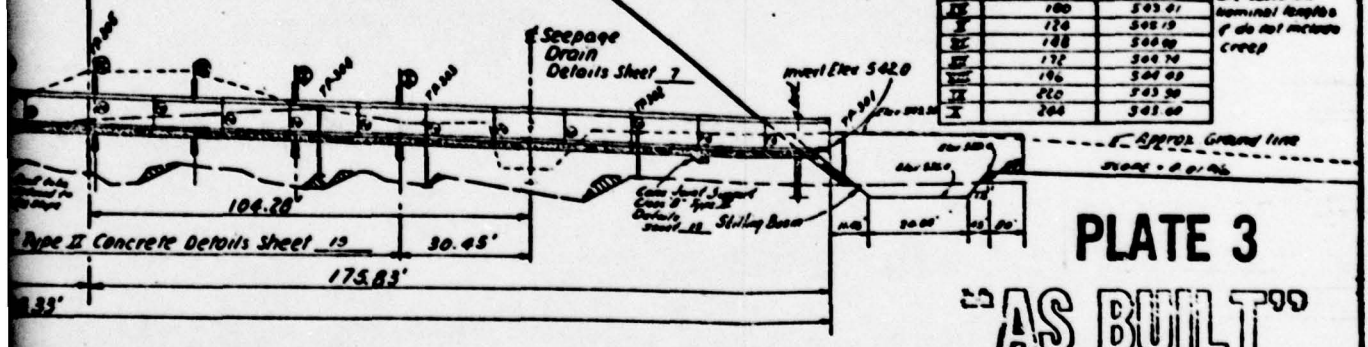
36" I.D. Reinf. Conc. Water Pipe
(21) 16'-0" Sections & (1) 8'-0" Section
(1) 12" Wall Piece
Total = 345.33'
Pressure Head = 57.5
Load: 4117.0 lbs per lin ft based on O.D of 42.66"
Min 3 edge bearing strength for 0.001" crack
Equals 7020 lbs per lin ft for Prestressed Pipe AWWA C-300
Min 3 edge bearing strength for 0.01" crack
Equals 9980 lbs per lin ft for Non Prestressed Pipe AWWA C-300

PIPE SUPPLIERS NOTE
Cast outside of Spigot Joint Ring
with Concrete on one 16'-0" Section

Point	Dist from Base Wall Fitting	Invert Elev of 36" Dia Pipe	Slope
48	24	596.69	Slope = 0.0009
56	60	595.94	
65	96	595.09	
86	72	595.66	
87	88	595.61	
88	104	595.37	
89	120	595.28	
90	136	595.09	
91	152	594.96	
92	168	594.80	
93	184	594.55	Slope = 0.0153
94	200	594.29	
95	216	594.00	
96	232	593.78	
97	248	593.53	
98	264	593.27	
99	280	593.02	
100	296	592.76	
101	312	592.51	
102	328	592.26	

	Anti Seep Collars	
I	50	594.05
II	82	593.89
III	96	593.82
IV	100	593.81
V	126	593.69
VI	188	593.98
VII	172	594.14
VIII	196	594.03
IX	220	593.90
X	264	593.60

ACC. Above figures for dist from base wall fitting to anti seep collars are based on nominal lengths & do not include creep



CENTERLINE OF PRINCIPAL SPILLWAY

Scale (vert.)

NOTE. Riprap shall be well graded from a min size of 6" to a max size of 18". It shall be placed with the longest dimension perpendicular to the line of flow. Backfill bedding with clean sand & gravel, as directed by the Engineer in field.

PLATE 3

"AS BUILT"

MULTIPLE PURPOSE DAM NO. 1
WHITE OAK RUN WATERSHED
MADISON COUNTY, VIRGINIA
PLAN - PROFILE OF PRINCIPAL SPILLWAY

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

L.S. Coffman 1963	
Lee Peck 4/64	VA-480-P

APPENDIX II

PHOTOGRAPHS

CONTENTS

Note: Photographs were taken on 28 November 1978.

NAME OF DAM: WHITE OAK

WHITE OAK DAM

PHOTO 1. Reservoir Area, Riser and Walkway

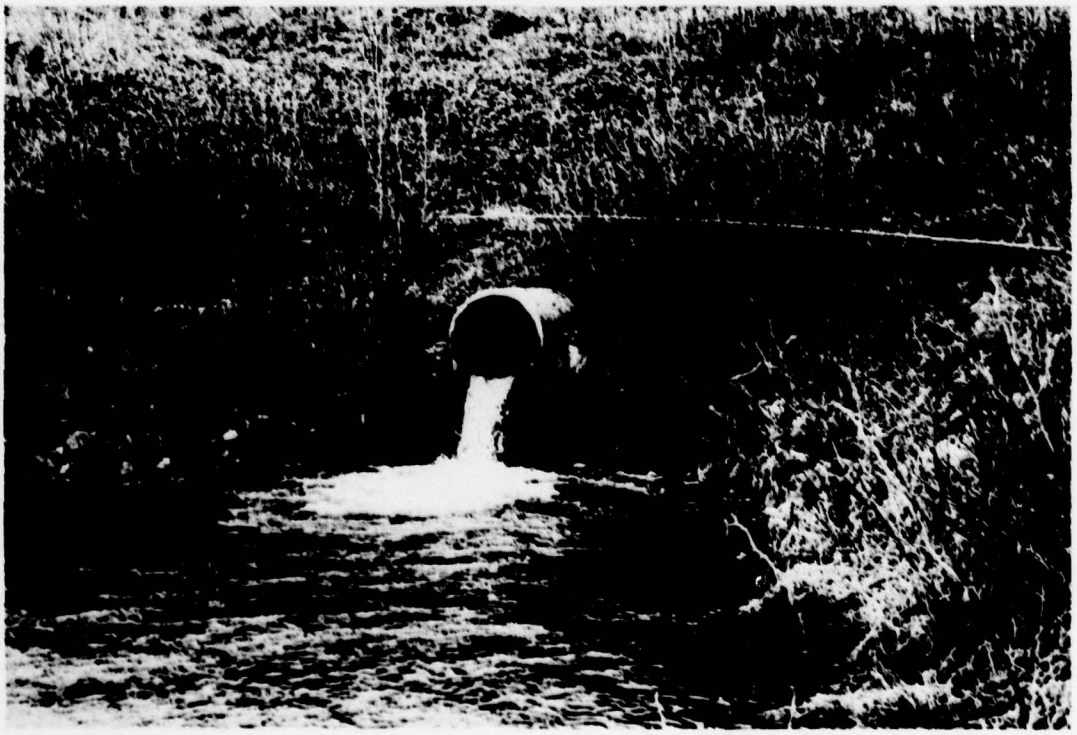


PHOTO 2. Concrete Outlet Pipe and Stilling Basin

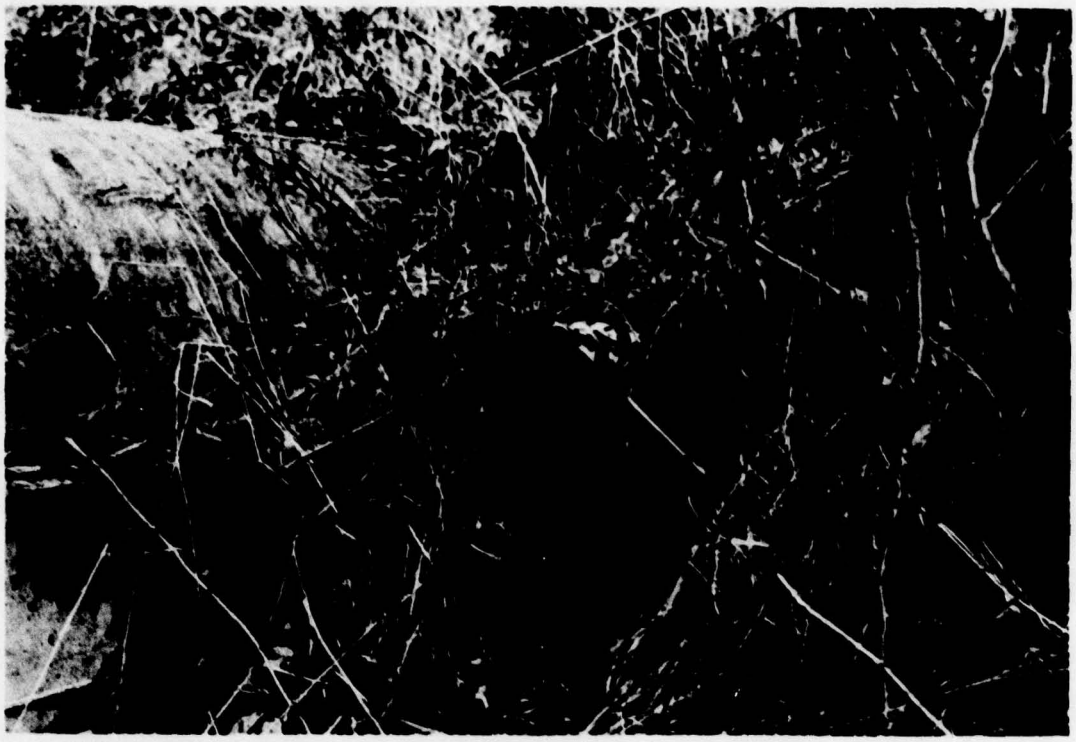


PHOTO 3. Seepage Drain (6-inch Outlet Pipe)

PHOTO 4. Outlet Channel for Emergency Spillway

APPENDIX III

CHECK LIST - VISUAL INSPECTION

Check List
Visual Inspection
Phase 1

Name of Dam White Oak County Madison State Virginia Coordinates Lat. 3822.8
Long. 7818.6

Date Inspection 28 November 1978 Weather Warm, Clear Temperature 55°F.

Pool Elevation at Time of Inspection 581.7 ft. M.S.L. Tailwater at Time of Inspection 539.1 ft. M.S.L.

Inspection Personnel:

Michael Baker, Jr., Inc.:

T. W. Smith
W. L. Sheafer
T. J. Dougan

Virginia Water Control Board:

Roy Murphy
Tim Perry

T. W. Smith Recorder

EMBANKMENT

Name of Dam: WHITE OAK

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	There is evidence of sloughing or erosion of the dam and abutment slopes.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Good	
RIPRAP FAILURES	No failures were observed in the stone riprap at the normal pool on the upstream slope.	
SLOPES	The downstream slope and the upper portion of the upstream slope were constructed at a 2.5:1 ratio. The upstream slope below the 10 ft. berm beneath the normal pool elevation has a 3:1 ratio. The slope has thick vegetation with some small trees. Driftwood is deposited on the left abutment near the lake shoreline.	The trees and driftwood should be removed.

EMBANKMENT

Name of Dam: WHITE OAK

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONSTRUCTION MATERIALS	The dam was constructed in 3 zones according to the plans: 1) silt and clay core, 2) silt and clay on upstream portion and upper part of the downstream slope, and 3) silty sand on lower part of downstream area. The surface soil was firmly compacted brown, damp, sandy silt with small rock fragments. There is a small animal burrow in the lower part of the downstream slope on the right abutment. The downstream toe is rock.	The burrow should be excavated, filled, and seeded.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	There is brown, damp sand and silt with traces of rock fragments at the left abutment slope. The bedrock consists of hard granite, alaskite, and greisen. Granite with a 70° dipping gneissic structure is exposed in the emergency spillway near the right abutment with silty sand and some rock fragments above the bedrock. Some small trees and bushes were observed in the unpaved slope gutters at the left abutment.	The trees and bushes in the slope gutters should be removed.
ANY NOTICEABLE SEEPAGE	No seepage from the embankment of the dam was observed. A small, clear seep (15 x 20 ft.) was observed in the saturated silty sand at the base of the left abutment 50 ft. downstream from the dam.	
STAFF GAGE AND RECORDER	None	Install a staff gage to monitor reservoir levels above normal pool.
DRAINS	There are 3 - 6 in. B.C.C.M.P. drains (see photo 3) in the vicinity of the outlet of the principal spillway pipe which remove water from the seepage drain. The pipe on the far left had a flow of 0.4 g.p.m. of clear water. The drain adjacent to the outlet pipe on the left was measured at 1/8 g.p.m. The pipe on the right side was dry.	

EMBANKMENT

Name of Dam: WHITE OAK

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
FOUNDATION	The foundation is brown, silty sand with gravel above weathered to hard granite with gneissic structure dipping at 70° according to the test borings shown in the plans. The joints are steep. The bedrock is of the Lovingston Formation, Blue Ridge complex. The cutoff trench is excavated to the top of the firm bedrock.	

OUTLET WORKS

Name of Dam: WHITE OAK

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Outlet conduit is in good condition (no visual spalling or cracking), and the concrete cradle under the pipe is well supported.	
INTAKE STRUCTURE	The intake structure is a R.C. riser with normal pool controlled by 2 orifice inlets (25 in. high by 36 in. wide at elevation 581.3 ft. M.S.L.). Riser crest is at elevation 586.5 ft. M.S.L. and has 2 intakes, 1 on each side of riser with each having an overflow weir length of 9 ft. A 36 in. reservoir drain is located at elevation 547.0 ft. M.S.L.	
OUTLET STRUCTURE	The flow in the 36 in. diameter R.C.P. was measured at a depth of 5 in. The pipe empties into a stilling basin approximately 40 ft. wide and 60 ft. long with stone riprap protection. Photo 2 shows the outlet pipe and stilling basin.	
OUTLET CHANNEL	From the stilling basin, the water flows into a well-defined channel downstream for about 100 to 200 ft. The overbanks are highly brush covered. About 200 ft. downstream, the stream channel becomes deeper as it enters a wooded area.	
EMERGENCY GATE	The emergency gate is a 36 in. slide gate which can be used to drain the reservoir.	
STILLING BASIN	There is a slide in the cut in the hillside into the stilling basin about 30 ft. from the outlet of the principal spillway in silt, gravel, cobbles, and boulders. Some of the riprap has slid into the stilling basin, but there is generally a good riprap coverage of the basin. There is vegetation on the slide providing some protection. The sloughing in a 20 ft. wide x 18 ft. maximum height area was caused by the stream undercutting the slope on the right side during a high water stage. There is no blockage in the basin.	

UNGATED SPILLWAY

Name of Dam: WHITE OAK

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	None	
APPROACH CHANNEL	Large rocks were placed at the approach on the bank of the reservoir. The soil is sandy silt and rock fragments above the hard granite bedrock. There is a good growth of vegetation on the soil. The emergency spillway has a 2% adverse slope to the level control section 30 ft. wide.	
DISCHARGE CHANNEL	The deepest portion of the cut for the channel is in hard granite with gneissic structure and covered with sandy silt to foster growth of grass. The outlet area is in sandy silt with little to some rock fragments. There is a grass cover. A small drainage ditch has been cut across the lower end and outlets into the stream in the woods. The exit channel has a positive slope of 16%. Photo 4 shows the discharge channel.	
BRIDGE AND PIERS	A steel catwalk, about 2.5 ft. wide and supported by four concrete piers, provides access to the riser.	
CUT SLOPES	The middle of the cut is in soft to hard granite with gneissic structure. The dip of the structure varies from 20° to 40° in a downstream direction. Steep joints have caused uneven breakage and some talus. The limits of the cut and the upper part above the bedrock are in brown sand and silt with little to some rock fragments and gravel at a 3:1 ratio. The slopes are well-covered with grass and some small trees.	The trees should be removed.

Name of Dam: WHITE OAK

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None observed.	
OBSERVATION WELLS	None	
WEIRS	None	
PIEZOMETERS	None	
OTHER		

RESERVOIR

Name of Dam: WHITE OAK

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	The ratio of the slopes ranges from gentle to moderately steep with woods and open areas in the vicinity of the cottages. There are boat docks and other recreational facilities. The soils consist of silt, sand, and variable quantities of rock fragments. Clayey silt is present in some areas. There are scattered exposures of bedrock. Photo 1 shows the reservoir area.	
SEDIMENTATION	No unusual sedimentation was noted around the riser and upstream embankment. However, local residents stated that sedimentation at the upstream end of the reservoir is occurring.	

DOWNSTREAM CHANNEL

Name of Dam: WHITE OAK

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	There are no obstructions or debris. The channel deepens and widens downstream as it enters the woods.	
SLOPES	The slopes are cut in brown, silty sand, gravel, cobbles, and small boulders and are stable. The channel slope is approximately 1% immediately downstream from the stilling basin.	
APPROXIMATE NO. OF HOMES AND POPULATION	There are a few scattered farms located downstream of the dam. Approximately 4 miles downstream is the Town of Madison with a population of 500.	

APPENDIX IV

CHECK LIST - ENGINEERING DATA

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

Name of Dam: WHITE OAK

ITEM	REMARKS

PLAN OF DAM A Plan of Dam, as contained in the as-built drawings, is included in this report as Plate 1.

REGIONAL VICINITY MAP is included in this report as Location Plan.

CONSTRUCTION HISTORY was obtained from the SCS. The contractor was Moore, Kelly and Reddish, Inc. The dam construction was completed in 1965.

TYPICAL SECTIONS OF DAM as contained in the as-built drawings are included in this report as Plates 2 and 3.

HYDROLOGIC/HYDRAULIC DATA is included in the SCS Design Report.

OUTLETS - **PLAN**
and
DETAILS contained in the as-built drawings.

- **CONSTRAINTS**
and
DISCHARGE RATINGS contained in the SCS Design Report.

RAINFALL/RESERVOIR RECORDS None available at dam site.

Name of Dam: WHITE OAK

ITEM	REMARKS
DESIGN REPORTS	The SCS Design Report was available for this study.
GEOLOGY REPORTS	The SCS Design Report contains the results of the soil and geologic studies.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	Hydrology and hydraulic calculations, stability analyses of the dam, and results of water pressure testing are contained in the SCS Design Report. The water pressure tests are also shown in the plans.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	Records of test pits and borings are presented in the as-built drawings. Laboratory test results and soil classifications are included in the Design Report.
POST-CONSTRUCTION SURVEYS OF DAM	None known.
BORROW SOURCES	Borrow areas are shown on the as-built drawings.

Name of Dam: WHITE OAK

ITEM	REMARKS
MONITORING SYSTEMS	No monitoring systems other than the spillway riser were designed into dam.
MODIFICATIONS	Field conditions were found to verify the as-built drawings indicating no major modifications were made to the dam.
HIGH POOL RECORDS	Water was approximately 0.5 ft. deep in the emergency spillway during the June 1972 flood.
POST-CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Other than annual inspections, no known post-construction engineering studies or reports have been completed.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None
MAINTENANCE OPERATION RECORDS	Annual inspections are conducted by the Town of Madison with the assistance of the SCS and the Culpeper Soil and Water Conservation District.

Name of Dam: WHITE OAK

ITEM	REMARKS
SPILLWAY PLAN, SECTIONS, and DETAILS	are contained in the as-built drawings.
OPERATING EQUIPMENT PLANS & DETAILS	Shown in the as-built drawings and consist of crank operated lifts with pedestal base (4 for future water supply and 1 for the reservoir drain).

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 5.06 sq.mi.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 581.3 ft. M.S.L. (629 ac.-ft.)

ELEVATION OF EMERGENCY SPILLWAY CREST (STORAGE CAPACITY): 592.0 ft. M.S.L. (1250 ac.-ft.)

ELEVATION MAXIMUM DESIGN POOL: 600.4 ft. M.S.L.

ELEVATION TOP DAM: 603.8 ft M.S.L. (settled)

CREST: Emergency Spillway

a. Elevation 592.0 ft. M.S.L.
b. Type Earth, side-channel with vegetative cover
c. Width 75 ft.
d. Length Total length 340 ft. (approach 100 ft., level section 30 ft., exit 210 ft.)
e. Location Spillover Outside right abutment
f. Number and Type of Gates Not Applicable

OUTLET WORKS:

a. Type Drop-inlet reinforced concrete riser
b. Location Riser in reservoir with 36 in. R.C.P. exiting into stilling basin
c. Entrance inverts 581.3 ft. M.S.L. (normal pool)
586.5 ft. M.S.L. (riser crest)
d. Exit inverts 542.0 ft. M.S.L. invert of concrete outlet pipe
e. Emergency draindown facilities 36 in. reservoir drain with invert at 547.0 ft. M.S.L.

HYDROMETEOROLOGICAL GAGES: Not available

a. Type
b. Location
c. Records

MAXIMUM NON-DAMAGING DISCHARGE: Unknown

Name of Dam: WHITE OAK

APPENDIX V

OPERATION AND MAINTENANCE INSPECTION REPORTS

White Oak Watershed
Annual Inspection

In compliance with policies and procedures outlined in WS Memo-Va-17, April 14, 1972, the annual inspection of the multi-purpose flood control and water storage structure designated as Site#1 of the White Oak Run Watershed in Madison County, Virginia was made on June 9, 1976. Assisting in the inspection were Madison Mayor Joe Drake; Harry Shepherd, Madison Filteration plant employee; James R. Grove, L. W. Kipps, H. S. Barksdale, and Mrs. Elizabeth Weaver, Culpeper S. W. C. D. Directors. Also, James Blair of the State Soil and Water Conservation Commission; Richard Reed and Garland Kidd of the Soil Conservation Service.

All items called for in the operations and maintenance agreement were inspected and the following observations and agreements were made:

1. Considerable brush is growing at the entrance to the emergency spillway and along the waterline of dam also miscellaneous brush is growing in emergency spillway and on both front and back side of dam. The Madison town council agreed to cut this brush.

2. On the back side of dam some areas are reverting to native vegetation, but all vegetation on dam and spillway is performing a good job of protecting areas from erosion.

3. Some rust spots are appearing on the metal railing of walk way leading to principal spillway. The town of Madison agreed to perform the needed paint work.

4. None of the four gate valves, that were installed for release of municipal water have been operated since they were installed in 1965. The District Directors recommended that the Town open and close these gate valves periodically. (once or twice a year)

This practice should improve the operation of these valves when needed to release water for municipal use.

S. W. C. D. Director

Mayor Town of Madison

Soil Conservation Service

OPERATION & MAINTENANCE INSPECTION REPORT

Submitted White Oak Run Watershed 1 Site

Inspected by L. W. Kipps, SWCD Director Date April 25, 1977
Garland W. Kidd, SCS
Jim Blodgett, SCS; Harry Shepherd, Town of Madison

1. Describe any erosion which needs corrective action.

None

2. Describe condition of vegetation cover. Identify required action.

Small areas of honeysuckle are starting on several spots of the dam, which is crowding out the Kentucky 31 fescue. This honeysuckle will be cut or otherwise suppressed to prevent futher encroachment on the Kentucky 31 fescue . Phosphate and potash will be maintained at a medium level and the PH between 5.5 and 6.5. The Town of Madison will do the needed work.

3. Describe woody vegetation on or near the embankment. Identify needed action.

Miscellaneous brush on the dam and in the spillway will be cut. The Town of Madison will do this work.

4. Condition of principal spillway inlet and outlet and foundation drain outlets. Identify needed action.

Principal spillway, inlet and outlet and foundation drains were in good condition and functioning. Small spots of rust are occuring on the guard rails and cat walk. These spots will be cleaned and painted by the Town of Madison.

Corrective action taken, date and cost.

The 1976 inspection report indicated that brush was to be removed from entrance to emergency spillway and other parts of dam. This brush has been cut.

The Town opened and closed the four gate valves satisfactorily as recommended in 1976 inspection report.

Garland W. Kidd
Soil Conservation Service
L. W. Kipps
District Chairman SWCD

OPERATION & MAINTENANCE INSPECTION REPORT

Submitted White Oak Run Watershed No. 1 Site

Inspected by Overton Weaver, SWCD Director Date May 18, 1978
Garland J. Kidd, SCS Stewart Miller, Town of Madison
James F. Blodgett, SCS E. Forrest Lohr

1. **Describe any erosion which needs corrective action.**

NONE

2. **Describe condition of vegetation cover. Identify required action.**

Kentucky #31 fescue and miscellaneous low growing vegetation provide sufficient cover for erosion control.

3. **Describe woody vegetation on or near the embankment. Identify needed action.**

Miscellaneous brush or woody growth is encroaching on more desirable type low growing vegetation on front and back side of Dam and at entrance to flood spillway. The Town of Madison will surpress or remove this brush.

4. **Condition of principal spillway inlet and outlet and foundation drain outlets. Identify needed action.**

Above mentioned facilities are in good condition and functioning as intended.

Corrective action taken, date and cost.

The four gate valves were opened and closed by the Town of Madison during 1977. The Town may want to consider doing this periodically to ascertain operability.

Garland J. Kidd
Garland J. Kidd
Soil Conservation Service

Sarah Frances Johnston
Sarah Frances Johnson
Mayor, Town of Madison

Overton Weaver
Overton Weaver
Director, Culpeper, SWCD

APPENDIX VI

STABILITY ANALYSIS

1963 STABILITY CALCULATIONS

VIRGINIA WP-08, WHITE OAK RUN, SITE NO. 1

STABILITY ANALYSIS PORTION RETYPED

STABILITY ANALYSIS:

The initial assumption of the stability analysis was that none of the less plastic and cohesionless soils would be utilized in the upstream slope. Unless otherwise specified, the analyses discussed were based on a modification of the Swedish Circle Method.

The first part of the analysis was based on ℄ Station 7+00, where the embankment will be 63.3 feet high. A complex upstream slope was analyzed; 2 1/2:1 slope above elevation 581.0, 10-foot berm at elevation 581.0 and 3:1 slope below elevation 581.0. It was assumed that failure would be limited to the embankment. The lowest factor of safety found was 1.37. This was based on the saturated shear parameters for Sample 63W3583 (CL) and assumed full drawdown. Study of this analysis led to the conclusion that the foundation would have to be considerably stronger than the embankment values used in order to resist failure. Therefore, additional foundation information was requested (Ref. 1). Density information obtained at the site, along with the gradation of Sample 63W3572, led to the assignment of shear parameters of $\phi = 25°$ and c = 100 p.s.f. to the foundation.

The second part of the analysis was based on conditions at Station 6+57 with a 5-foot foundation having parameters of $\phi = 25°$, c = 100 p.s.f. At Station 6+57 the dam will be 57.8 feet high. It was found that the 2 1/2:1/3:1 slope with a 10-foot berm at elevation 581.0 gave a factor of 1.12 against embankment-foundation failure. It was found that an additional 26-foot berm at elevation 566.0 was required to bring the factor of safety up to 1.34.

The downstream slope of the embankment was initially assumed to be 2 1/2:1 with a drain at c = 0.6b. Infinite slope analysis for a dry slope like Sample 63W3577 (non-plastic SM) gave a factor of safety of 1.65. Sliding Wedge analysis of the 2 1/2:1 slope sliding on the 25°-100 p.s.f. foundation gave a factor of safety equal to 1.97. Ordinarily, a factor greater than 2.0 is the minimum of acceptibility for the Sliding Wedge analysis. The Swedish Circle Method of analysis gave a factor equal to 1.15 for the 2 1/2:1 slope with a drain at c = 0.6b and with a 5-foot "correlated" foundation. It was found that a 28-foot berm at elevation 566.0 is required to raise this factor of safety to 1.50.

RECOMMENDATIONS

A. Cutoff and Drainage: A positive cutoff is recommended. This will require penetration to sound bedrock. A wide trench bottom is recommended in the zone below the

normal pool to assure good bond with the bedrock. A bottom width of 20 feet should be adequate. During the excavation of the cutoff into the abutments, the bedrock should be carefully examined. Open seams and mud seams should be repaired with "dental grouting", so that the cutoff will not be exposed to flow. The cutoff should be backfilled with some of the more plastic materials compacted to 95 percent of Standard density.

Foundation drainage will not be required, since positive cutoff is to be provided. However, embankment drainage is required for stability and protection against piping. In the areas where there are seams, it is desirable to extend the embakment drain down to pick up the flow. This can be done with blind drain, if the seams are scattered and few. An attached Form SCS 353 shows the recommended filter limits. A thickness of at least 12 inches of filter should be used. The drain should be located at c = 0.6b and should extend to elevation 576.

B. Principal Spillway: The principal spillway location appears to be satisfactory. Total consolidation and maximum horizontal unit strain are expected to be quite low. Since the entire principal spillway has been trenched out with pits, it is recommended that the trench be cut with a 20-foot bottom on bedrock and with 2:1, or flatter, side slopes. This trench should be backfilled with some of the materials recommended for the upstream slope. The backfill should be compacted to at least 95 percent of Standard density with moisture contents very near optimum. It is recommended that a protective filter entirely surround the conduit at the drain line.

C. Embankment Design: There are three basic alternatives that are consistent with the data available and the analyses based on those data. Briefly, these alternatives are (1) remove and re-compact or replace the questionable alluvium from the floodplain and the abutment mantle up to approximately elevation 550, (2) provide extra berming (or flatter slopes) to raise the factor of safety to an allowable value, or (3) secure undisturbed samples of the questionable materials for sheer testing, and base design on the strengths obtained. The specific recommendations for Alternates 1 and 2 are outlined more fully below.

1. Slopes:

Alternate 1 (Removal)

Upstream: 2 1/2:1 above elevation 581.3, 10-foot berm at elevation 581.3, 3:1 below elevation 581.3.

Downstream: 2 1/2:1; drain at c = 0.6b.

Alternate 2 (Extra Berming)

Upstream: 2 1/2:1 above elevation 581.3, 3:1 below elevation 581.3, 10-foot berm at elevation 581.3, 26-foot berm at elevation 566.0.

Downstream: 2 1/2:1 with a 28-foot berm at elevation 566.0; drain at c = 0.6b.

The remaining recommendations apply both to Alternates 1 and 2.

2. Placement of Materials: (See attached Form SCS 372.) A plan of selective placement is recommended which utilizes more plastic, cohesive soils in the upstream slope and less plastic, low cohesion (in some cases cohesionless, free draining) materials in the downstream slope. It is extremely important to keep the soils with little or no cohesion out of the upstream slope, since drawdown would tend to cause surface failures in such materials. Placing the less plastic materials downstream will also help assure drawdown of the phreatic surface by the drain, thus guarding the downstream slope face against steady seepage. Since the stability analysis assumed this condition, it is also rather important. The plan of selective placement agrees, for the majority of the materials, with the plan recommended by the Geologist. The differences are based primarily on grain size distribution and plasticity considerations.

1 -- R. [illegible] Burger, Jr. -- [illegible] 63
[illegible]
[illegible]

R E T Y P E D   O N   VI-1   T H R O U G H   VI-3

One point on each compaction curve was run on material with the "natural moisture content" (as received). A study of these points indicates that most materials except the SM's will probably require drying. The "natural moisture" point for [illegible] of the samples gave densities below 95 percent of Standard density. Several other samples contained moisture above what is felt a desirable upper placement limit.

C. Permeability: Most of the available borrow materials are expected to have low rates of permeability at placement densities. There are some materials available, however, that contain rather low percentages of clay-sized particles. These may be moderately permeable.

D. Shear Strength: Consolidated, undrained shear tests were performed on 5 different borrow samples remolded to approximately 95 percent of Standard density and saturated. Results of these tests are tabulated below. It is felt that these tests satisfactorily cover the range of materials to be used and the test results are recommended for design.

Sample No.	Classification	Dry Unit Density (pcf)	% of Max. Standard	Deg. of Sat.	φ'	c'
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	CH-CL	102.6	[illegible]	95.[illegible]	24.0	[illegible]
63WB[illegible]	ML	96.1	95.1	91.[illegible]	[illegible]	[illegible]
63WB582	ML	95.1	95.7	92.5	22.0	[illegible]
63WB583	CL	96.1	95.6	93.8	[illegible]	[illegible]

E. Consolidation: It is estimated that at the maximum section the embankment will settle 3 percent of its height after construction is complete, due to consolidation of embankment materials.

STABILITY ANALYSIS:

The initial assumption of the stability analysis was that none of the less plastic and cohesionless soils would be utilized in the upstream slope. Unless otherwise specified, the analyses discussed were based on a modification of the Swedish Circle Method.

The first part of the analysis was based on [illegible] Station 7+00, where the embankment will be [illegible] feet high. A complex upstream slope was analyzed; 2 1/2:1 slope above elevation 581.0, 10-foot berm at elevation 581.0 and 3:1 slope below elevation 581.0. It was assumed that failure would be limited to the embankment. The lowest factor of safety found was 1.37. This was based on the saturated shear parameters for Sample 63WB583 (CL) and assumed full drawdown. Study of this analysis led to the conclusion that the foundation would have to be considerably stronger than the embankment values used in order to resist failure. Therefore, additional foundation information was requested (Ref. 1). Density information obtained at the site, along with

5 -- L. C. Barnes, Jr. -- 7/21/65
Roy S. Decker
Subj: Virginia WI-10, White Oak Run, Site No. 1

RETYPED ON VI-1 THROUGH VI-3

the gradation of Sample 6543572, led to the assignment of shear parameters of $\phi = 25°$ and $c = 100$ p.s.f. to the foundation.

The second part of the analysis was based on conditions at ℄ Station 6+57 with a 5-foot foundation having parameters of $\phi = 25°$, $c = 100$ p.s.f. At Station 6+57 the dam will be 57.8 feet high. It was found that the 2 1/2:1/3:1 slope with a 10-foot berm at elevation 561.0 gave a factor of 1.12 against embankment-foundation failure. It was found that an additional 20-foot berm at elevation 566.0 was required to bring the factor of safety up to 1.3+.

The downstream slope of the embankment was initially assumed to be 2.1/2:1 with a drain at $c = 0.6b$. Infinite slope analysis for a dry slope like Sample 6543577 (non-plastic SM) gave a factor of safety of 1.65. Sliding Wedge analysis of the 2 1/2:1 slope sliding on the 25°-100 p.s.f. foundation gave a factor of safety equal to 1.97. Ordinarily, a factor greater than 2.0 is the minimum of acceptability for the Sliding Wedge analysis. The Swedish Circle Method of analysis gave a factor equal to 1.15 for the 2 1/2:1 slope with a drain at $c = 0.6b$ and with a 5-foot "correlated" foundation. It was found that a 28-foot berm at elevation 566.0 is required to raise this factor of safety to 1.50.

RECOMMENDATIONS

A. Cutoff and Drainage: A positive cutoff is recommended. This will require penetration to sound bedrock. A wide trench bottom is recommended in the zone below the normal pool to assure good bond with the bedrock. A bottom width of 20 feet should be adequate. During the excavation of the cutoff into the abutments, the bedrock should be carefully examined. Open joints and and seams should be treated with "dental grouting", so that the cutoff will not be exposed to flow. The cutoff should be backfilled with some of the more plastic materials compacted to 95 percent of Standard density.

Foundation drainage will not be required, since positive cutoff is to be provided. However, embankment drainage is required for stability and protection against piping. In the areas where there are seeps, it is desirable to extend the embankment drain down to pick up the flow. This can be done with blind drain, if the seeps are scattered and few. An attached Form SCS 353 shows the recommended filter limits. A thickness of at least 12 inches of filter should be used. The drain should be located at $c = 0.6b$ and should extend to elevation 576.

B. Principal Spillway: The principal spillway location appears to be satisfactory. Total consolidation and maximum horizontal unit strain are expected to be quite low. Since the entire principal spillway has been trenched out with pits, it is recommended that the trench be cut with a 20-foot bottom on bedrock and with 2:1, or flatter, side slopes. This trench should be backfilled with some of the materials recommended for the upstream slope. The backfill should be compacted to at least 95 percent

R E T Y P E D   O N   VI-1   T H R O U G H   VI-3

of Standard density with moisture contents very near optimum. It is recommended that a protective filter entirely surround the conduit at the drain line.

C. <u>Embankment Design</u>: There are three basic alternatives that are consistent with the data available and the analyses based on these data. Briefly, these alternatives are [illegible] or (3) secure undisturbed samples of the questionable materials for shear testing, and base design on the strengths obtained. The specific recommendations for Alternates 1 and 2 are outlined more fully below.

1. <u>Slopes</u>:

<u>Alternate 1 ([illegible])</u>

<u>Upstream</u>: [illegible] above elevation [illegible], [illegible]-foot berm at elevation [illegible] 3:1 below elevation [illegible].

<u>Downstream</u>: [illegible]

<u>Alternate 2 ([illegible])</u>

<u>Upstream</u>: 2 1/2:1 above elevation [illegible], 3:1 below elevation 531.3, 10-foot berm at elevation 531.3. 25-foot berm at elevation 565.0.

<u>Downstream</u>: [illegible] with a [illegible]-foot berm at elevation [illegible]; drain at c = [illegible].

The remaining recommendations apply to both Alternates 1 and 2.

2. <u>Placement of Materials</u>: (See attached Form SCS 372.) A plan of selective placement is recommended which places most plastic, cohesive soils in the upstream slope and less plastic, low cohesion (in some cases cohesionless, free draining) materials in the downstream slope. It is extremely important to keep the soils with little or no cohesion out of the upstream slope, since drawdown would tend to cause surface failures in such materials. Placing the less plastic materials downstream will also help assure drawdown of the phreatic surface by the drain, thus guarding the downstream slope face against steady seepage. Since the stability analysis assumed this condition, it is also rather important. The plan of selective placement agrees, for the majority of the materials, with the plan recommended by the Geologist. The differences are based primarily on grain size distribution and plasticity considerations.

FORM SCS-357
10-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
SOIL MECHANICS LABORATORY

SUMMARY - SLOPE STABILITY ANALYSIS

State Virginia Project White Oak Run Site #1

Date 6-12-63 Analysis Made By T.C.H. Checked By G.N.G.

Method of Analysis Swedish Circle

Location of Material	Emb 95% Std SM		Emb 95% Std CL-ML		Emb 95% Std ML		Emb 95% Std ML		Emb 95% Std CL	
Sample No.	63W3577		63W3579		63W3581		63W3582		63W3583	
γ_d	102.1		100.2		86.1		95.2		96.1	
γ_m	118.5		118.5		107.5		115.0		116.5	
γ_s	125.0		124.5		114.0		120.5		121.5	
γ_b	62.5		62.0		51.5		58.0		59.0	
Condition	Opt.	Sat.	Opt.	Sat.	Opt.	Sat.	Opt.	Sat.	Opt.	Sat.
ϕ	33.5°			24.0°		17.5°		22.0°		31.5°
Tan ϕ	0.662			0.445		0.315		0.404		0613
K	0.290									
C	0			600		775		725		300

UPSTREAM SLOPE

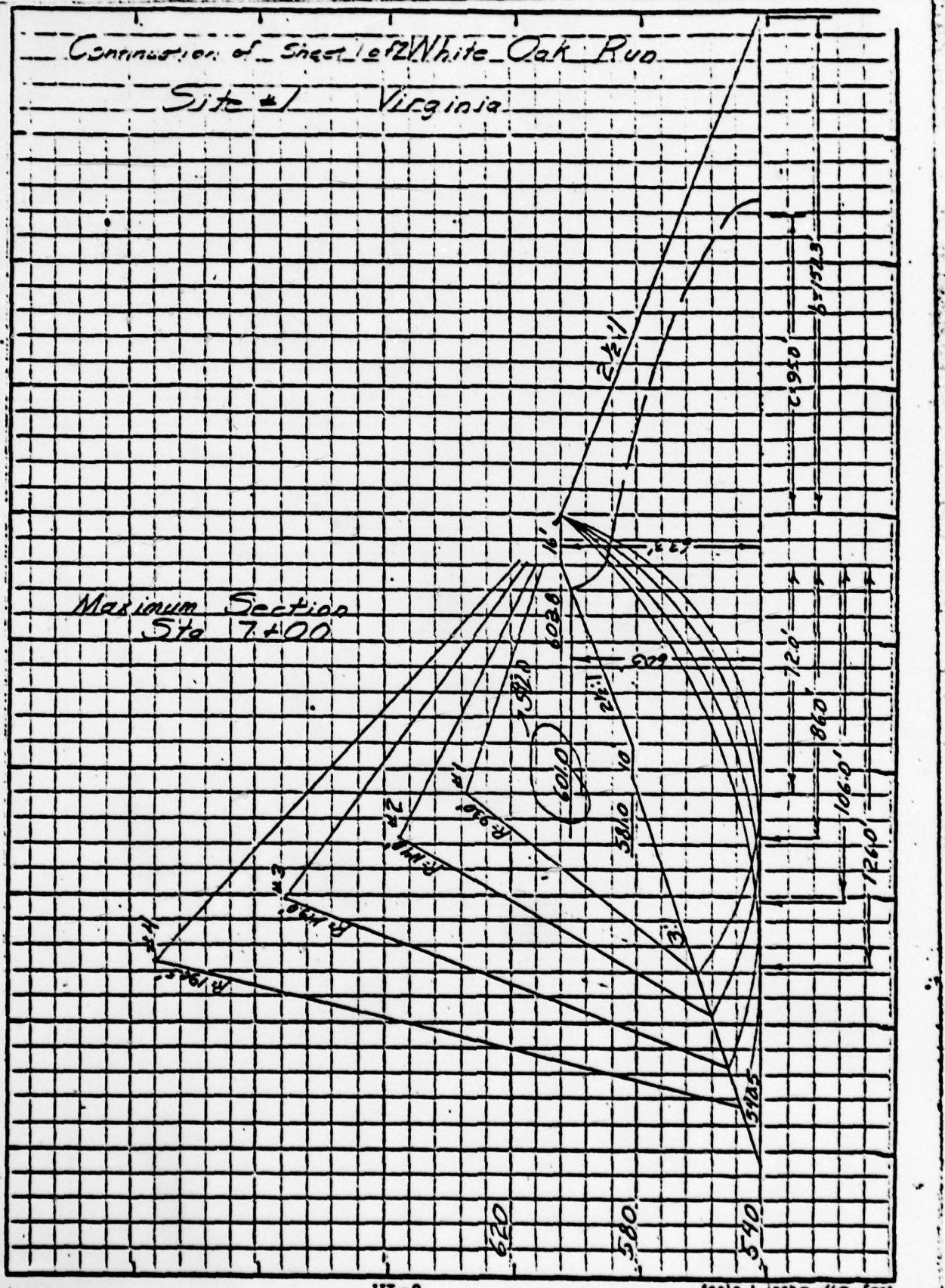
Trial	Slope	Conditions	Fs
1	2½:1 3:1	Full draw down - 10' berm @ el. 581.0 - Arc cut from upp slide thru emb 63W3581 only - Sat. shear values only	1.69
1A	2½:1 3:1	Same as #1 except emb 63W3582	1.73
1B	2½:1 3:1	Same as #1 except emb 63W3579	1.61
2	2½:1 3:1	Same as #1B except tangent point moved 14' toward toe	1.54
2A	2½:1 3:1	Same as #2 except emb 63W3583	1.37
3	2½:1 3:1	Same as #2A except tangent point moved 20' toward toe	1.39
4	2½:1 3:1	Same as #3 except tangent point moved an additional 20' toward toe.	1.41

DOWNSTREAM SLOPE

Trial	Slope	Conditions	Fs

To be used to report to field offices data used for slope stability analyses and the results of the analyses. The right side of the form will be used for a sketch of the embankment on which the analyses have been made.

GPO: 1959 O-489388


Continuation of Sheet 1 of 2 White Oak Run
Site #1 Virginia
Maximum Section
Sta 7+00
2:1
16'
10'
2:1
1'
2'
3'
620
580
540
scale 1 inch = 40 feet

FORM SCS-357
10-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
SOIL MECHANICS LABORATORY

SUMMARY - SLOPE STABILITY ANALYSIS

State VIRGINIA Project WHITE OAK RUN Site # 1

Date 7-11-63 Analysis Made By G.N.G Checked By T.C.H.

Method of Analysis Swedish Circle

Location of Material	Found ML				Sheet 1 of 3 Emb. Mat'l.					
Sample No.	Correlated.									
γ_d	83.0									
γ_a										
γ_s	114.5									
γ_b	52.0									
Condition	Opt.	Sat.	Opt.	Sat.	Opt.	Sat.	Opt.	Sat.	Opt.	Sat.
ϕ		25.0°								
Tan ϕ		0.466								
K										
C		100								

UPSTREAM SLOPE

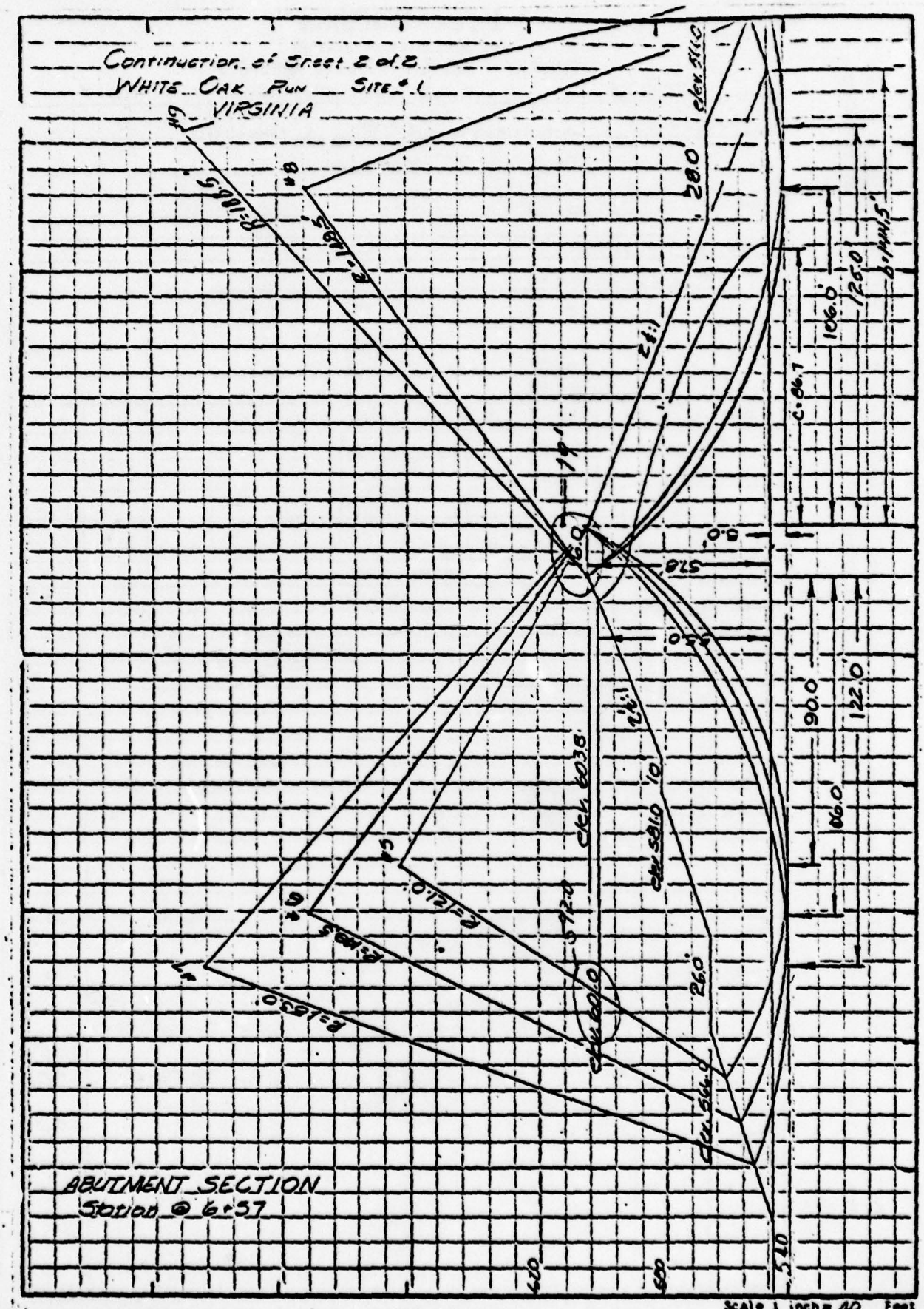
Trial	Slope	Conditions	Fs
5	2½:1 / 3:1	Full drawdown - 10.0' berm @ elev. 381.0 - Arc cut from opp. shldr thru Emb 63W3583 @ 5.0' Correlated Found. (25.0° - 100) - Sat. shear values only.	1.14
6	2½:1 / 3:1	Same as #5 but Tangent Point moved upstream 16.0'.	1.12
7	2½:1 / 3:1	Same as #5 but Tangent Point moved upstream 16.0'.	1.12
5A	2½:1 / 3:1	Same as #5 but 26.0' berm added at elev. 366.0	1.34
6A	2½:1 / 3:1	Same as #6 but 26.0' berm added at elev. 366.0	1.35
7A	2½:1 / 3:1	Same as #7 but 26.0' berm added at elev. 366.0	1.34

DOWNSTREAM SLOPE

Trial	Slope	Conditions	Fs
8	2½:1	Drain @ elev 0.6 - No berm - Arc cut from opp. shldr thru Emb 63W3577 @ 5.0' Correlated Found. Sat. shear values only.	1.15
8A	2½:1	Same as #8 but 28.0' berm @ elev. 366.0	1.50
9	2½:1	Same as #8A but tangent point moved dist'n. 19.0'	1.53

To be used to report to field offices data used for slope stability analyses and the results of the analyses. The right side of the form will be used for a sketch of the embankment on which the analyses have been made.

GPO: 1959 O-499133


Continuation of Street E of E
WHITE OAK RUN SITE #1
VIRGINIA
R=185.5'
R=185.5'
R=10.0'
R=10.0'
R=10.0'
19'
2:1
2:1
2:1
2:1
Elev. 5510
Elev. 6038'
Elev. 5928
Elev. 5910
Elev. 5660
280
278
26.0'
106.0'
122.0'
90.0'
106.0'
510
500
400
ABUTMENT SECTION
Station @ 6+57
Scale 1 inch = 40 Feet

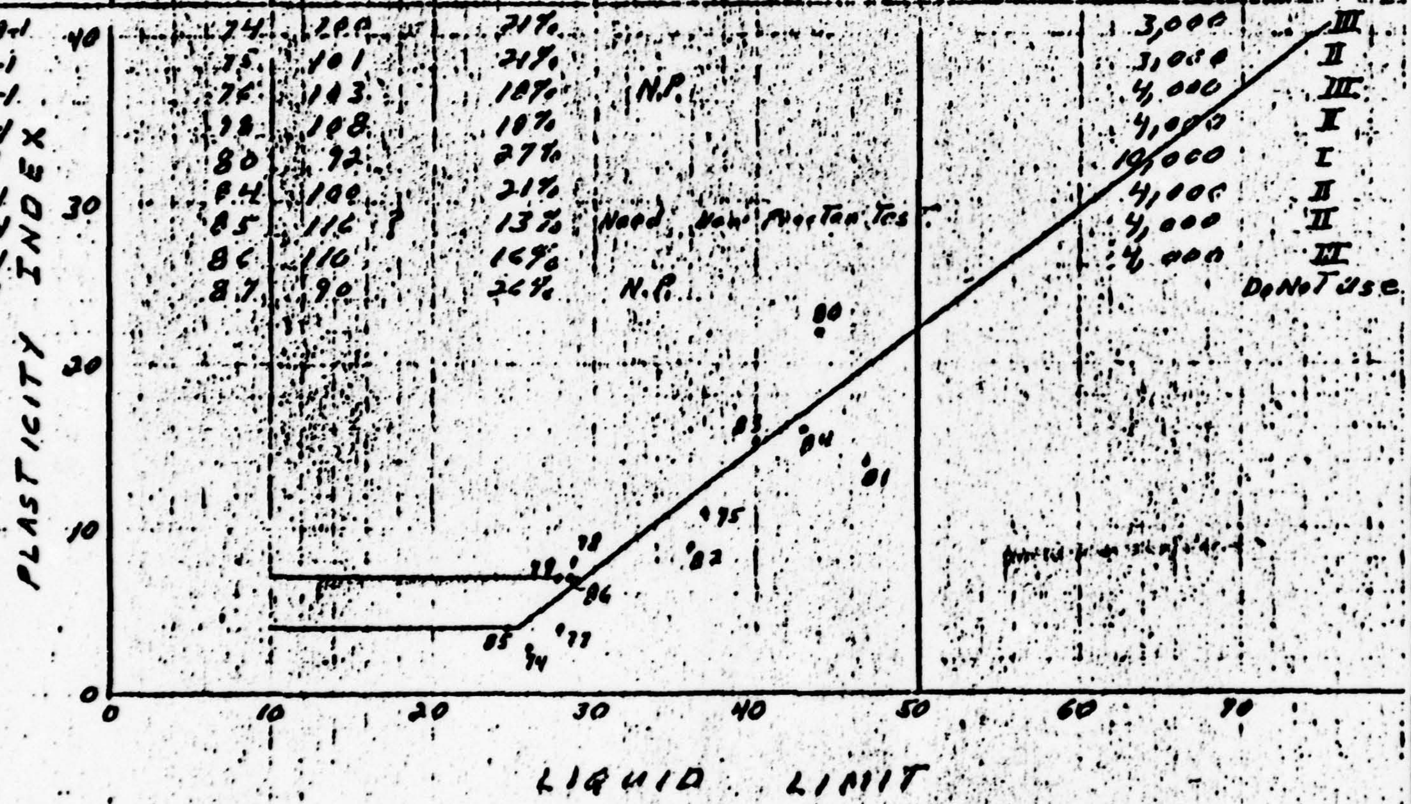
1964 STABILITY CALCULATIONS

COMPUTATION SHEET
SCS-523 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE VIRGINIA PROJECT WHITE OAK SITE #1
BY SCR DATE 2/19/64 CHECKED BY RAG DATE 9-17-64 JOB NO. VA-480-E
SUBJECT SECTIONING OF EMBANKMENT SHEET 1 OF

Field No.	Lab No.	Compaction Test γ_d	Compaction Test ω	Shear Data @ 3% Strain γ	Shear Data @ 3% Strain φ	Shear Data @ 3% Strain C	Available Quantity	Section
106-1	63W3577	108	16%	102	24°	445	13,000	III
110-1	79	107	19%	100	22°	575	9,000	II
121-1	81	92	25%	86	12°	1,000	13,000	I
129-1	82	101	21%	95	18.5°	850	35,000	II
133-1	83	99	21%	96	18.5°	300	16,000	II
209-1	74	100	21%				3,000	III
211-1	75	101	21%				3,000	II
216-1	76	113	10%	N.P.			4,000	III
108-1	78	108	10%				4,000	II
119-1	80	92	27%				10,000	I
137-1	84	100	21%				4,000	II
146-1	85	116	13%	Need Non Friction Test			4,000	II
148-1	86	110	16%				4,000	III
150-1	87	90	26%	N.P.				Do Not Use



COMPUTATION SHEET
SCS-523 REV 9-58

U. S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE [illegible] PROJECT [illegible] WHITE [illegible]

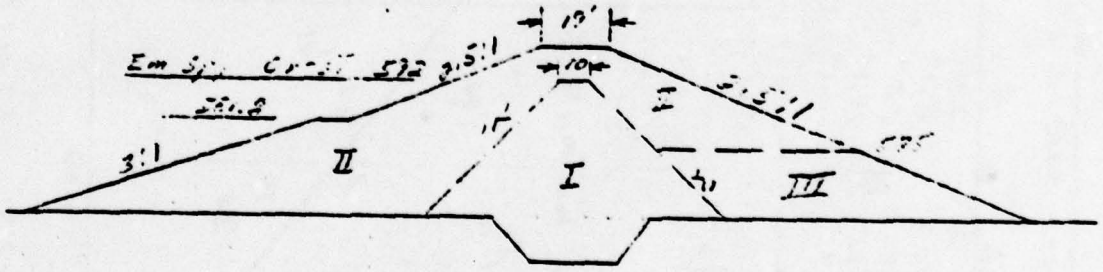
BY SCS DATE [illegible] CHECKED BY TAS DATE 3-17-59 JOB NO [illegible] 2 E

SUBJECT SECTION AND ESTIMATE OF EMBANKMENT SHEET 2 OF [illegible]

USE OF BORROW MATERIALS

Section	Quantity Available	Quantity Used	% of Total Fill
I	23,000	23,000	22 %
II	75,000	51,000	51 %
III	24,000	24,000	23 %
TOTAL	122,000	104,000	100

Excludes Foundation Excavation and Channel Trenches which may be Used in the Fill with Excess Suitable Material.



Proportions For Borrow Soil Use Estimated Using Normal Cross Section At Station 67+17.

Section I Compacted Fill Class "E"
Use Silt (ML) and Clay (CL)
Represented by The Log of Test Pits
119 from 1' To 9'
121 from 1' To 10'

Section II Compacted Fill Class "E"
Use Silt (ML) and Clay (CL)
Represented by The Log of Test Pits
211 from 1' To 11'
108 " 1' To 2'
110 " 1' To 8'
129 " 1' To 7'
133 " 1' To 14'
137 " 1' To 4'
146 " 1' To 11'

COMPUTATION SHEET
SCS-523 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE VIRGINIA PROJECT White Oak Site #1
BY SCF DATE 4/15/64 CHECKED BY RAG DATE 5-17-64 JOB NO. VA-480-E
SUBJECT Sections of EMBANKMENT SHEET 3 OF

Section III Compacted Fill Cross B2'
Use Silty soils (SM) Represented
by The Log of Test Pits
209 from 1' To 6'
216 " 1' To 11'
186 " 1' To 4'
148 " 1' To 12'

Check Stability of Proposed
Sections Using The following
Values:

Section I
$\phi = 12°$ $c = 1,000$ psf @ 3% Strain
$\gamma_s = 92$ pcf
$\gamma_m = 105$ pcf
$\gamma_c = 120$ pcf
$\phi = 17.5°$ $c = 775$ psf
from Lab Envelope

Section II
$\phi = 18.5°$ $c = 500$ psf
$\gamma_s = 100$ pcf
$\gamma_m = 121$ pcf
$\gamma_c = 125$ pcf
$\phi = 31.5°$ $c = 300$ psf
from Lab Envelope

Section III
$\phi = 24°$ $c = 400$ psf
$\gamma_s = 102$ pcf
$\gamma_m = 123$ pcf
$\gamma_s = 127$ pcf
$\phi = 33.5°$ $c = 0$ psf
from Lab Envelope

Foundation
$\phi = 18°$ $c = 100$ p.s.f.
$\gamma_s = 90$ pcf
$\gamma_m = 104$ pcf
$\gamma_s = 118$ pcf
$\phi = 25°$ $c = 100$ psf
from Lab Report

SHEET 4

MISSING FROM SCS COPY

SHEET 5

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COMPUTATION SHEET
SCS-522 REV 5-58

U S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE VIRGINIA PROJECT WHITE OAK SITE NO. 1

BY FAE DATE 2-25-64 CHECKED BY [illegible] DATE 3/10/64 JOB NO VA-451-E

SUBJECT STABILITY OF DOWNSTREAM SLOPE SHEET 6 OF _____

NOTE: USE LAB RECOMMENDATIONS FOR SHEAR VALUES

SECT II $\phi = 31.5°$ $C = 300$ psf

SECT III $\phi = 33.5°$ $C = 0$ psf

FOUND. $\phi = 25°$ $C = 100$ psf

clb = $34.5 \times 1 \times 300 = 10,350$#
$54.2 \times 1 \times 0 = 0$
$80.2 \times 1 \times 100 = 8020$#
TOTAL: 18,370#

N TAN ϕ = $0.82 \times 24960 \times 0.615 = 12,540$#
$4.52 \times 24960 \times 0.662 = 74,650$#
$6.90 \times 24960 \times 0.167 = 80,450$#
TOTAL: 167,640#

$$SF = \frac{167.6 + 18.4}{132.2} = \frac{186.0}{132.2}$$

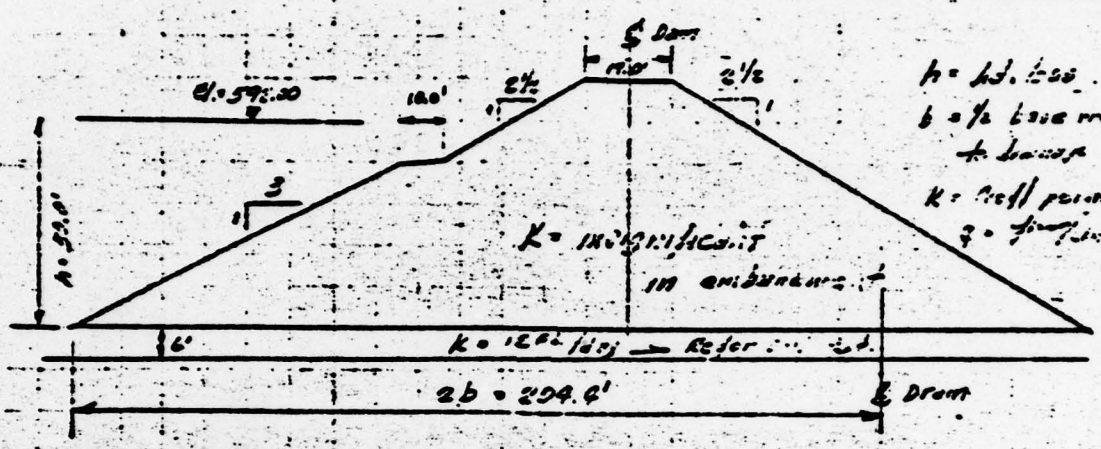
SF = 1.41

NOTE: DOWNSTREAM FOUNDATION MATERIAL IS ACCEPTABLE.

COMPUTATION SHEET
SCS-522 REV 5-58

U S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Virginia PROJECT White Oak Run No. 1
BY E DATE 3/18/64 CHECKED BY DATE JOB NO. VA-483-5
SUBJECT Capacity of Drainage System SHEET 7 OF



h = hd. loss
b = ½ base width of barrel opening
k = coeff. permeability
q = flow thru K

Flow Thru Fill Embankment

Flow Thru Fdtn. (Conservative Because Cutoff is to Impervious Bedrock)

Use Darcy Eq. $q = k\,h/L\,A$

$q = 12\left(\frac{50}{294.4}\right)6 = 17.6$ Ft³/Day

Flow Thru Abutments

Use Darcy Eq. $q = Kh\frac{nf}{nc}$ Assume $\frac{nf}{nc} = 0.5$ for flow net shape

$\int dq = K\frac{nf}{nc}\int_0^{50} h\,dh$

$q = K\frac{nf}{nc}\left[\frac{h^2}{2}\right]_0^{50}$

$q = 12(0.5)\left[\frac{2500-0}{2}\right] = 14994$ Ft³/day

Total Drainage Flow Ltd. Wide D. Survey (Looking D.S. in Drainage Dr. Pipe

$Q = 17.6(60) + 14994 = 16050$ Ft³/day $= \frac{16050\ \text{Ft}^3/\text{day}}{5.403\ \text{Ft}^3/\text{cf}} = 2.97$ cfs

≈ 3.0 cfs

Check Capacity 6" ϕ C.M.P. for Intercept drain pipe

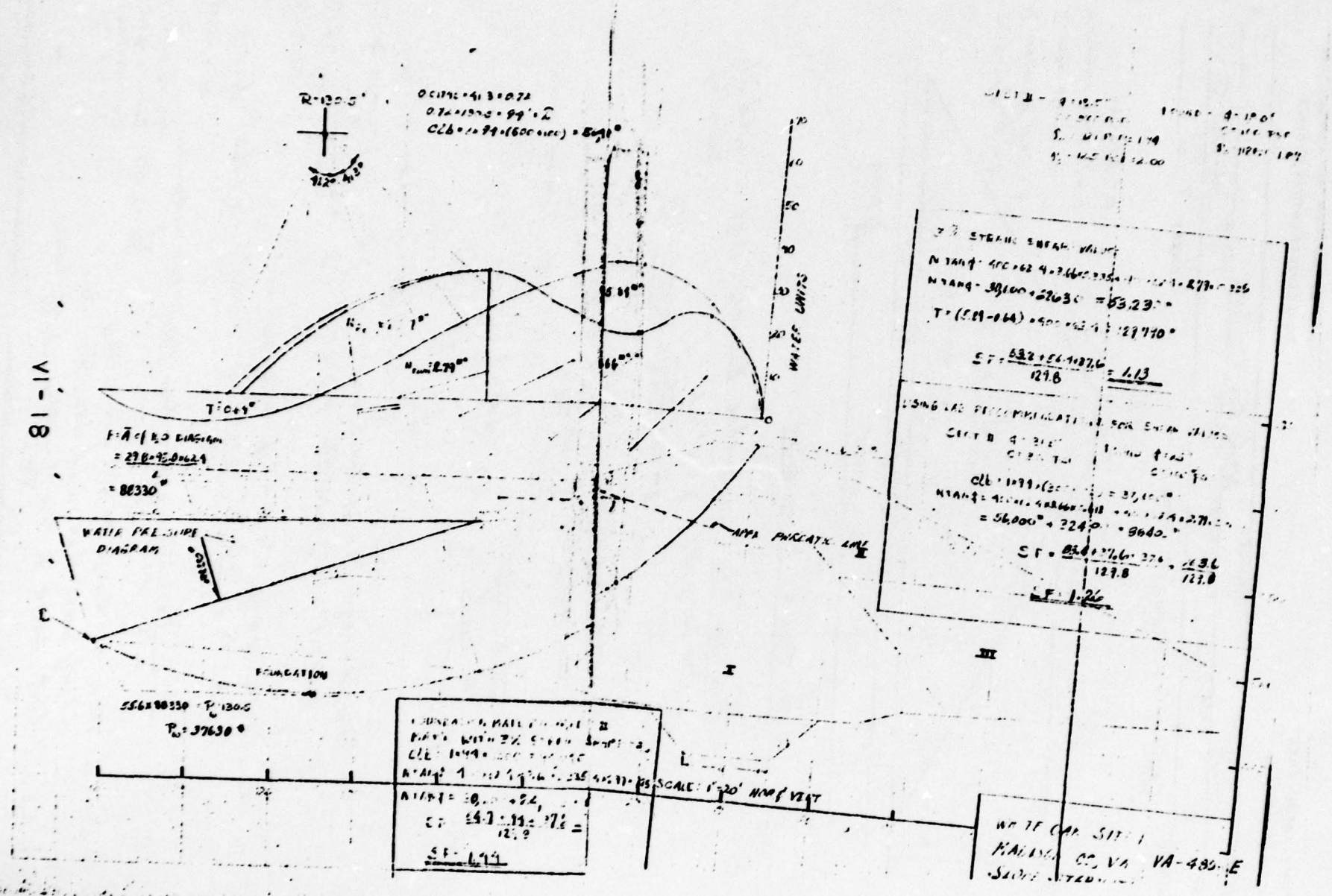
$AR^{2/3} = \frac{nQ}{1.49S^{1/2}} = \frac{0.024(3.0)}{1.49(0.01)^{1/2}} = \frac{0.0243}{0.149} = 0.0322$ $d_o = 0.5'$

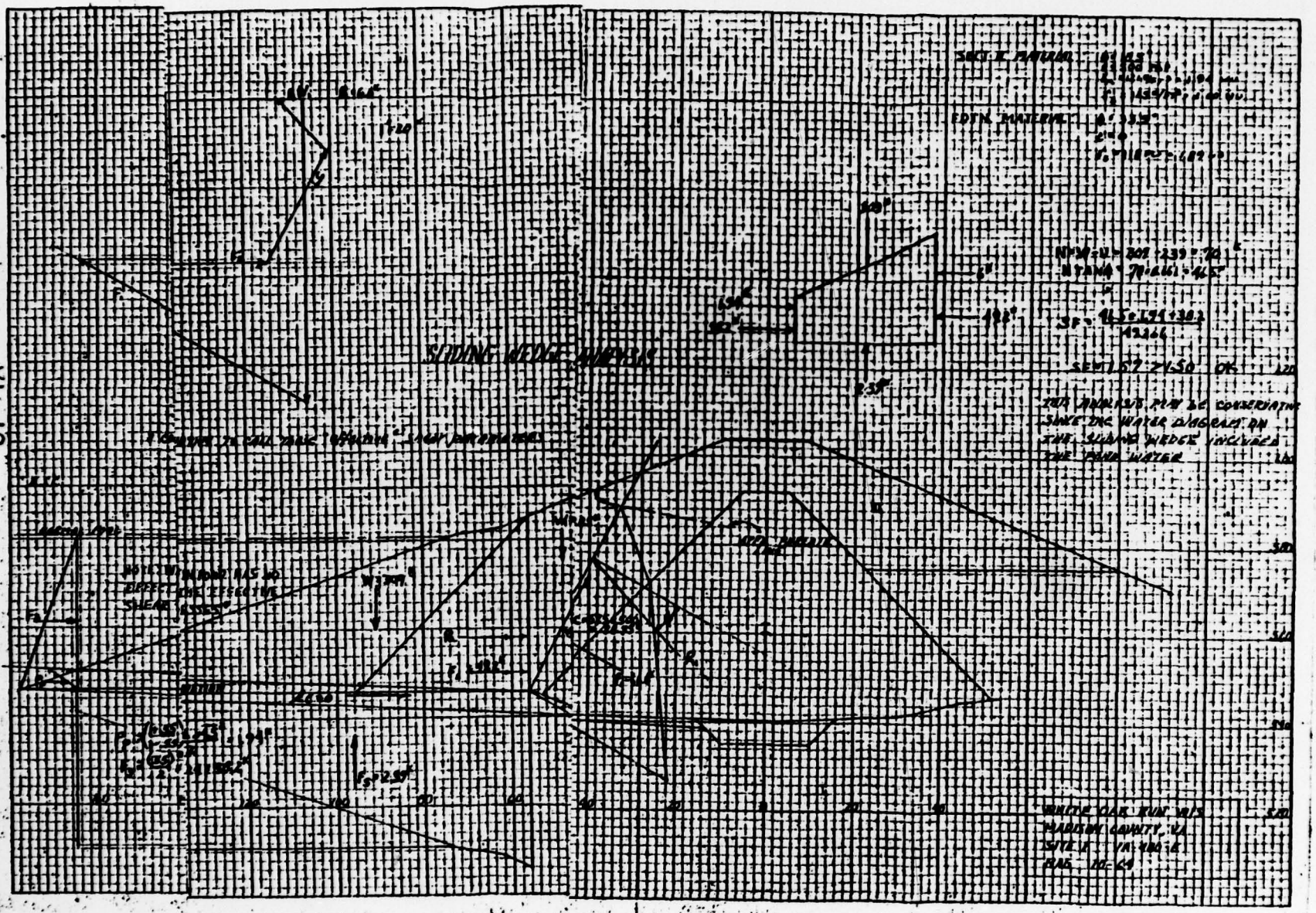
$d^{8/3} = 0.157$

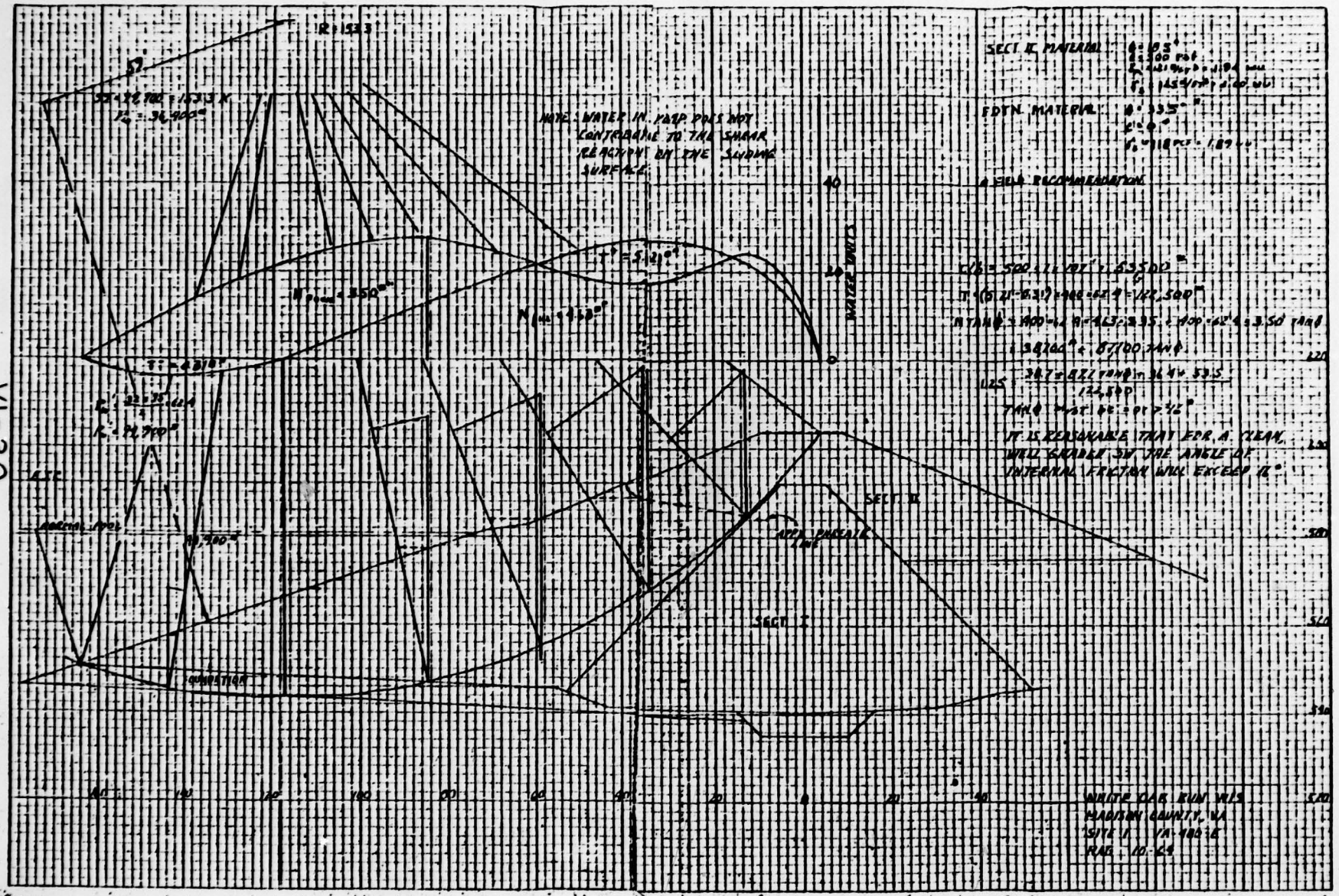
$\frac{AR^{2/3}}{d^{8/3}} = \frac{0.2333}{0.157} = 0.205$ - From Chow "Open Ch. Hydraulics"

$Y/d_o = 0.59$ This is satisfactory because of conservative assumptions

Flow in Drainage Dr. Fdt. wide Dr. Survey. Slightly Less than 3.0 cfs wide. Flow thru Abut. some & Flow Thru Fdtn. Slightly Less.


R=130.5'
Δ 112° 45'
T=64'
WATER PRESSURE DIAGRAM
ELEVATION
SCALE: 1"=20' HOR & VERT
WATER LINES
I
II
III


SLIDING WEDGE ANALYSIS
ROCK MATERIAL
JOINT MATERIAL
SEMI-67 2-50 OK
WHITE OAK RUN VA 5
MADISON COUNTY, VA
SITE 1A VA WHITE
RUN NO. 64


R = 1533
NOTE: WATER IN JOINT DOES NOT CONTRIBUTE TO THE SHEAR REACTION ON THE SLIDING SURFACE.
SECT II MATERIAL
EDTN. MATERIAL
A FIELD RECOMMENDATIONS
IT IS REASONABLE THAT FOR A CLEAN, WELL GRADED SAND THE ANGLE OF INTERNAL FRICTION WILL EXCEED 32°
SECT II
SECT I
ACTIVE PHREATIC LINE
ABUTMENT APPROACH
WHITE OAK RUN VALLEY
MADISON COUNTY, VA.
SITE I VA 488-6
FIG. NO. 6A

VI-20

APPENDIX VII

GEOLOGIC REPORT

Sheet 1 of 23

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

GENERAL

State Virginia County Madison ; ___ R. ___ W. Sec ___, T ___ N ___ ; Watershed White Oak Run

Subwatershed White Oak Run Fund class WP-308 (PL 566, WP 1, etc.) Site number 1 Site group I Structure class b

Investigated by L. A. Gorman & T. Mack (Signature and title) Equipment used Caterpillar D-6 Bulldozer John Decre tractor mounted backhoe (Type, size, make, model, etc.) Date March 1963

SITE DATA

Drainage area size 5.06 sq. mi. 3238 acres. Type of structure Earthfill Purpose Water Supply & Flood Prevention

Direction of valley travel (upstream) SE Maximum height of fill 60 feet. Length of fill 700 feet.

Estimated volume of compacted fill required 80,000 yards

STORAGE ALLOCATION

	Volume (ac. ft.)	Surface Area (acres)	Depth at Dam (feet)
Sediment	139	16.8	15
Floodwater	835	79.8	58
Water supply	500	46.0	27

SURFACE GEOLOGY AND PHYSIOGRAPHY

Physiographic description Piedmont province Topography Mountainous Attitude of beds: Dip ___ Strike ___

Steepness of abutments: Left 40 percent Right 20 percent. Width of floodplain at centerline of dam 100 feet

General geology of site: The dam site is in an area predominately underlain by granite. A large amphibolite (hornblende plagioclase feldspar gneiss) dike occurs approximately 275 feet west of the centerline of the dam. The strike of this dike in this area is generally N 45° E.

Minerals occurring in the granite are orthoclase and plagioclase feldspar, biotite quartz and pyroxene. The granite ranges from coarse grained to porphysitic in texture. Crystals of feldspar generally form the porphyries. It has been assigned by Nelson (1962) to the Virginia Blue Ridge complex which is of PreCambrian age.

The minerals in the amphibolite dike are hornblende and plagioclase feldspar. Of these hornblende is by far the most abundant. This gives the rock a black slightly vitreous luster. The plagioclase occurs in wavy gneissic bands that are generally about an inch apart and less than a tenth of an inch in thickness.

Nelson, W. A., 1962, Geology of Albemarle County, Virginia: Va. Geology Survey Bull. 68 16.

Also present is a minor amount of quartenary alluvium. This is on the banks of the larger streams which flow in a strongly entrenched dendritic drainage pattern.

Form SCS-347
Sheet 1 of 2
For in-service use only

USDA-SCS

9-69

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

State Virginia County Madison Watershed White Oak Run Subwatershed -

Site number I Site group I Structure class b Investigated by L.A.Gorman & T. Mack Date March 1963
(signature and title)

For in-service use only

INTERPRETATIONS AND CONCLUSIONS

1. Abutment foundation conditions appear adequate. Hard firm bedrock was encountered on the centerline of the dam. Very minor vertical jointing was observed. This should cause no trouble. As the rock is igneous and massive , no bedding is present.

2. The principal spillway was trenched out and a rock line established. Hard unweathered bedrock was found forming a continuous shelf generally 6 feet below ground level.

3. An impermeable core should be installed and the core trench should extend for one foot into the unweathered bedrock.

4. Foundation drains may have to be installed, although a 2 foot thick gravel layer exists below the silty sand covering the flood plain. This gravel layer might possibly be used as a natural filter. Sample 3 of 2 is a representative of this gravel.

5. The emergency spillway cut appears to be composed of shallow soil and unweathered bedrock. Bedrock excavation will be necessary. The bedrock is hard resistant granite. he site will be drilled and a supplementary report will be issued.

6. Sufficient borrow material is present in the borrow area. Enclosed is a soil correlation table.

7. This dam is to be a water supply structure,so precautions should be taken to insure the safety of the dam because of the greater depths of water. The bedrock underlying this proposed structure is quite impermeable, so the amount of water going to the local ground water will be negligible, therefore, the only consideration should be the safety of the structure. The site will be drilled and additional information regarding permeability and leakage zones will be issued in a supplementary report.

L.A. Gorman

VA-480-G

SOILS CORRELATION TABLE
AND
ESTIMATED AVAILABLE [illegible] - 3 -

(To Accompany Geology Report for Interpretations of Use)

Watershed White Oak Run Site No. I State VA Prepared by Mack, T Date Mch. 1963

Representative Sample for Lab.			Represents Soils from			Purpose or Suggested Use	Est. Available Quantity Cu. Yds.	Remarks
Field No.	Depth From - To	Unif. Class.	Hole No.	Depth From - To	Unif. Class.	Location			
110-1	1 - 8	ML	110			Borrow Area	Core etc.	9,000	fairly deep
			109	1 - 4	ML	Ditto	Ditto		Meadowville
			111	1 - 5	ML	"	"		soil colluvial
			113	1 - 5	ML or SM	"	"		
			114	1 - 10+	ML	"	"		
			120	1 - 5	ML	"	"		
106-1	1 - 4	SM to GM	106			"	Downstream Toe	13,000	Shallow
			103	1 - 3	ML to SM	"	"		Brandywine
			104	1 - 3	ML	"	"		Soil Residual
			105	1 - 4	SM	"	"		
			106	1 - 4	SM to GM	"	"		
			107	1 - 3	SM to GM	"	"		
			115	1 - 3	ML	"	"		
			116	1 - 4	ML to SM	"	"		
			130	1 - 5	SM	"	"		
			152	1 - 4	ML to GM	"	"		
129-1	1 - 7	ML to SM	129			"	"	35,000	Deep
			101	1 - 7	ML to SM	"	"		Brandywine
			102	1 - 9+	ML to SM	"	"		Soil residual
			122	1 - 8+	ML	"	"		

[illegible]-SCS Unit
[illegible] Darby, Pa.
January 10, 1962

2 of 6

SOIL CORRELATION SHEET

- 5 -

(To Accompany Geology Report for Pre-Service Design Unit)

Watershed White Oak Run Site No. I State VA. Prepared by Mack, T Date Mch. 1963

Representative Sample for Lab.			Represents Soils from			Purpose or Suggested Use	Est. Avail. Quantity Cu. Yds.	Remarks
Field No.	Depth From - To	Unif. Class.	Hole No.	Depth From - To	Unif. Class.	Location		
30-1	1 - 14+	ML	150			Borrow Area	Core, etc. 4,000	Tusquitee soil deep colluvial
			147	1 - 8+	ML	"	ditto	
148-1	1 - 12+	SM	148			"	Downstream Toe 4,000	Tusquitee soil deep colluvial
			144	1 - 7+	SM to GM	"	"	

Prepared by Engineering Unit
Soil Mechanics Laboratory
Upper Darby, Pa.
January 10, 1962

346

SOILS CORRELATION TABLE

AND

ESTIMATED AVAILABLE [illegible]

(To Accompany Geology Report for In-Service [illegible])

Watershed White Oak Run Site No. 1 State VA. Prepared by Mack, T. Date Mch. 1963

Representative Sample for Lab.			Represents Soils from				Purpose or Suggested Use	Est. Avail. Quantity Cu. Yds.	Remarks
Field No.	Depth From - To	Unif. Class.	Hole No.	Depth From - To	Unif. Class.	Location			
			214	1 - 7+	ML to SM	Emergency Spillway	Downstream Toe		
216-1	1 - 11+	SM	216			"	Core etc.	4,000	Deep Tusquitee
			212	1 - 11+	ML or SM	"	Ditto		
			217	1 - 11+	ML to SM	"	"		Soil Colluvial
133-1	1 - 14+	ML to SM	133			Borrow area	Core etc.	16,000	Deep Dyke
			139	1 - 13+	ML to SM	"	Ditto		Soil Colluvial
			140	1 - 7+	ML to SM	"	"		
			141	1 - 10+	ML to GM	"	"		
			142	1 - 9	ML	"	"		
			145	1 - 9	ML	"	"		
			151	1 - 12+	ML	"	"		
137-1	1 - 4	ML	137				Core, etc.	4,000	shallow Davidson
			143	1 - 5	ML to GM	"	Ditto		soil residual
119-1	1 - 9+	ML	119				"	10,000	Deep Davidson
			112	1 - 8+	ML		"		Soil residual
			117	1 - 8+	ML		"		
121-1	1 - 10+	ML	121				"	13,000	Deep Starr
			126	1 - 8+	ML		"		and Davidson
			127	1 - 8+	ML or SM		"		soil colluvial

[illegible]-Exp Unit
[illegible]er Darby, Pa.
Jan[illegible] 10, 1962

4486

SOIL CORRELATION TABLE

(To Accompany Geology Report for Detention Storage Dam)

Watershed White Oak Run Site No. I State VA Prepared by Mack, T. Date Mch. 1963

Representative Sample for Lab.			Represents Soils from				Purpose or Suggested Use	Est. Avail. Quantity Cu. Yds.	Remarks
Field No.	Depth From - To	Unif. Class.	Hole No.	Depth From - To	Unif. Class.	Location			
J9-1	1 - 6	ML to SM	209			Emergency Spillway	Downstream Toe	3,000	very shallow
			202	1 - 2	ML to SC	"	Ditto		Soil little
			206	1 - 4	ML to SC	"	"		use, Eubanks
			210	1 - 2	SM	"	"		Clifton Series
			213	1 - 4	SM	"	"		residual
			215	1 - 2	SM	"	"		
			218	1 - 4	ML to SM	"	"		
			219	1 - 1	GM	"	"		
			123	1 - 3	ML to SM	Borrow Area	"		
			135	1 - 1	ML	"	"		
			136	1 - 3	GM	"	"		
1-1	1 - 11+	ML to SM	211			Emergency Spillway	"	3,000	fairly shallow
			201	1 - 5	SM to SC	"	"		Brandy-wine
			203	1 - 4	SM to SC	"	"		Soil residual
			204	1 - 9+	SM to SC	"	"		
			205	1 - 4	SM to SC	"	"		
			207	1 - 5	SM to SC	"	"		
			211	1 - 11+	ML to SM	"	"		
			208	1 - 7	ML to SM	"	"		

-EWP Unit
er Derby, Pa.
nuary 10, 1962

596

SOILS CORRELATION TABLE

ESTIMATED AVAILABILITY

(To Accompany Geology Report for Reservoir Design Data)

Watershed White Oak Run Site No. I State VA. Prepared by Mack, T. Date Mch. 1963

Representative Sample for Lab.			Represents Soils from			Purpose or Suggested Use	Est. Avail. Quantity Cu. Yds.	Remarks
Field No.	Depth From - To	Unif. Class.	Hole No.	Depth From - To	Unif. Class.	Location		
			124	1 - 9+	ML to SM	Borrow Area	Downstream Toe		
			128	1 - 9+	ML to SM	"	"		
			129	1 - 7+	ML to SM	"	"		
			131	1 - 7+	ML	"	"		
			134	1 - 10+	ML to SM	"	"		
			138	1 - 9+	ML to SM	"	"		
			149	1 - 9+	ML to SM	"	"		
			153	1 - 16+	ML to SM	"	"		
303-1	1 - 5	SM	303			℄ of pipe	Foundation		Alluvial
303-2	5 - 7	SM	303			"	"		Congaree Soil
			301	1 - 6	SM to GM	"	"		
			302	1 - 6	SM to GM	"	"		
			304	1 - 9	SM to GM	"	"		
			305	1 - 6	ML to GM	"	"		
			306	1 - 6	SM to GM	"	"		
			307	1 - 7	SM to GM	"	"		
			308	1 - 7	SM to GM	"	"		
108-1	1 - 8+	ML	108			Borrow Area	Core, etc.	4,000	Tusquitee soil deep colluvial
			118	1 - 8+	ML	"	ditto		
146-1	1 - 11+	ML to SM	150			"	"	4,000	Tusquitee soil deep colluvial

4-SMP Unit
per Darby, Pa.
January 10, 1962

6986

Resume' of Pressure Testing

A total of four holes were tested. The following is a resume' of the results:

DH-1 - 4 ∠ 90 ℄ Dam Elev. 581.2'

Zone 6.0 - 11.0'
- 14 GPM at 5 PSI
- 17 GPM at 10 PSI
- 18 GPM at 20 PSI
- 22 GPM at 30 PSI

Zone 11.0 - 40.0'
- No leakage @ 30 PSI

DH-2 - 8 ∠ 13 ℄ Dam Elev. 582.3'

Zone 5.0 - 10.0
- 10 GPM at 5 PSI
- 12 GPM at 10 PSI
- 13 GPM at 20 PSI
- 17 GPM at 30 PSI

Zone 10.0 - 15.0
- 1 GPM at 30 PSI

Zone 15.0 - 20.0
- 8 GPM at 5 PSI
- 13 GPM at 10 PSI
- 14 GPM at 20 PSI
- 15 GPM at 30 PSI

Zone 20.0 - 42.2 (bottom of hole)
- No leakage at 30 PSI

DH-3 - ℄ Dam and ℄ Spillway 550.1'

Zone 11.9 - 16.9
- No leakage at 5 PSI
- 1 GPM at 30 PSI

DH-4 - 5 ∠ 30 ℄ Dam Elev. 575.7'

Zone 3.5 - 8.5
- 13 GPM at 10 PSI
- 22 GPM at 30 PSI

Zone 5.5 - 10.5
- No leakage at 30 lbs. pressure

APPENDIX VIII

REFERENCES

REFERENCES

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16. U.S. Department of Commerce, "Technical Paper No. 40, Rainfall Frequency Atlas of the United States for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years," Weather Bureau, Washington, D.C., May 1961.